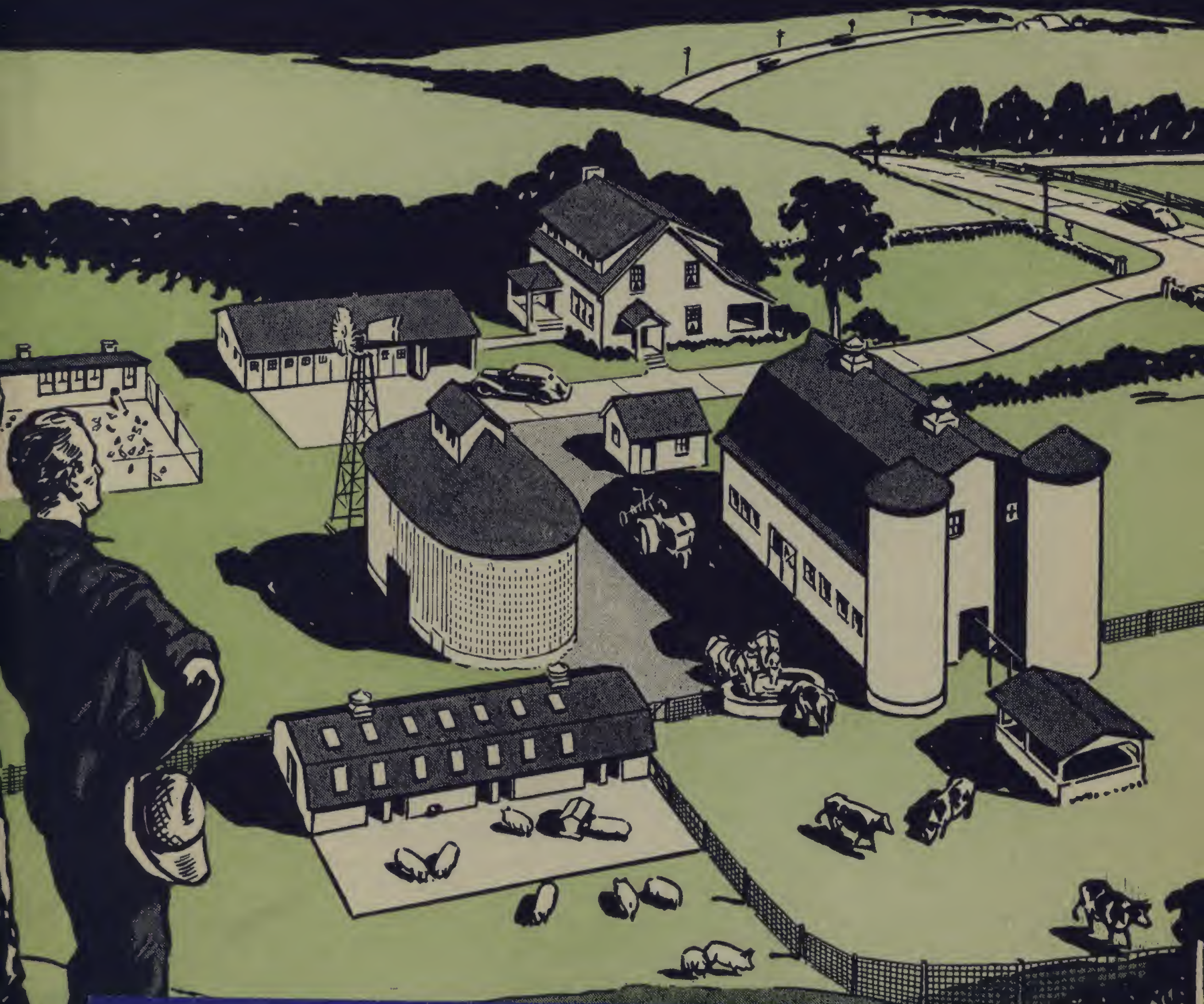
PLANS FOR CONCRETE FARM BUILDINGS



LEHIGH PORTLAND
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ALLENTOWN, PA., CHICAGO, ILL., SPOKANE, WASH.

To Those Planning Farm Buildings:

In planning a new building, two necessities stand out. First, cost of building must be reasonable. Few farm owners and operators can afford to "over-build." Second, a type of construction which assures long life without necessity of frequent repairs and other upkeep expenses will prevent a constant drain on farm income in future years. If, in addition, the type of construction selected provides qualities such as firesafety, attractive appearance, high degree of weather protection and similar advantages, the investment will be still more sound.

Shrewd analysis of building materials commonly used on farms today will point squarely to some form of concrete construction. First cost of concrete is reasonable. No other material of comparable cost assures such low maintenance and repair costs. Used on the farm, concrete provides the same degree of firesafety that it gives to large office buildings, hotels and city apartments housing hundreds . . . sometimes thousands . . . of people.

On the farm, with fire-fighting facilities miles away, firesafe construction is doubly important. Insurance alone can seldom replace loss of a valuable dairy herd or a season's crops. Well-designed concrete farm buildings offer maximum protection from fire.

We hope the building plans and information about making quality concrete, shown on the following pages, will help you to solve your building problems most economically.

Portland Cement Association

Concrete buildings form permanent improvements that will serve for years to come with minimum expense for repairs and upkeep and informing all who see them that the owner has invested his building dollars wisely.

The ease with which concrete is kept clean an sanitary is an advantage welcomed by the hog raise

This attractive concrete masonry barn, finished with white portland cement paint, is a landmark for miles around.

A paved entrance to the farmyard is a real convenience in muddy weather, besides adding to neatness and attractiveness.

(Above) Corn and small grains are secure against weather and rodents when stored in a concrete stave crib.

(Left, above) A concrete milk house with concrete cooling tank makes easier the production of high quality milk and cream.

(Left) For the poultry flock, too, the sanitation made possible with concrete construction helps reduce losses from parasites and disease.

(Above) Dairy, general purpose barn and silo, all of concrete.

Neat and attractive outside; spick, span and sanitary inside.

Plans for Concrete Farm Buildings

PLANS presented in this booklet are intended to provide ideas and suggestions for proper design and construction of needed farm buildings and improvements. Practically all the plans, selected from thousands of designs, have been accepted as standard by farm building specialists. Most of the plans show details necessary for constructing the different types of buildings. Use of these plans, together with general instructions regarding construction given on pages 51 to 67, will simplify the work and insure best results. Economy of construction as well as more efficient buildings are possible when these building helps are studied and utilized.

For the larger buildings where the services of a contractor are to be employed, blueprints are often desirable. Any of the farm building plans shown in this booklet can be obtained free on request. Blueprints should be ordered by number given in description under drawing.

When a building of different dimensions than are given in these plans is desired, the builder himself can generally sketch his requirements on paper by following closely the general design given.

When planning structures of different sizes than those shown in the following pages, estimating information given on page 56 will be found useful for figuring material requirements.

The construction of the farm residence should generally be undertaken only by an experienced builder and with adequate plans and construction details.

Estimates of materials required to complete the concrete work accompany the plans. These are approximate quantities and may vary 10 per cent either way, depending on the proportions and character of aggregate which is selected.

A barn of concrete masonry is a permanent improvement, attractive in appearance and low in upkeep cost.

An Attractive General Purpose Barn

THE appearance of the barn means much to any farm, just as much as fences meant in the days when "a farmer was judged by his fences." Appearance of buildings is generally accepted by the public as an index of the business ability and efficiency of the farm operator.

Barn of smooth faced concrete masonry units, one of several popular and attractive types available everywhere.

The general purpose barn in the plan shown can be altered to give any capacity desired. The dotted lines indicate how either end of the barn can be extended to provide additional stalls; likewise the barn can be shortened as required. It can be built to house dairy cattle only; or, with only minor changes, made to cover the requirements of a horse barn. The silo and feed bins are located near the center. This saves steps at feeding time; also permits future extension of the barn at either end. The type of roof framing shown on page 6 gives the maximum amount of clear loft space, yet is economical and rigid.

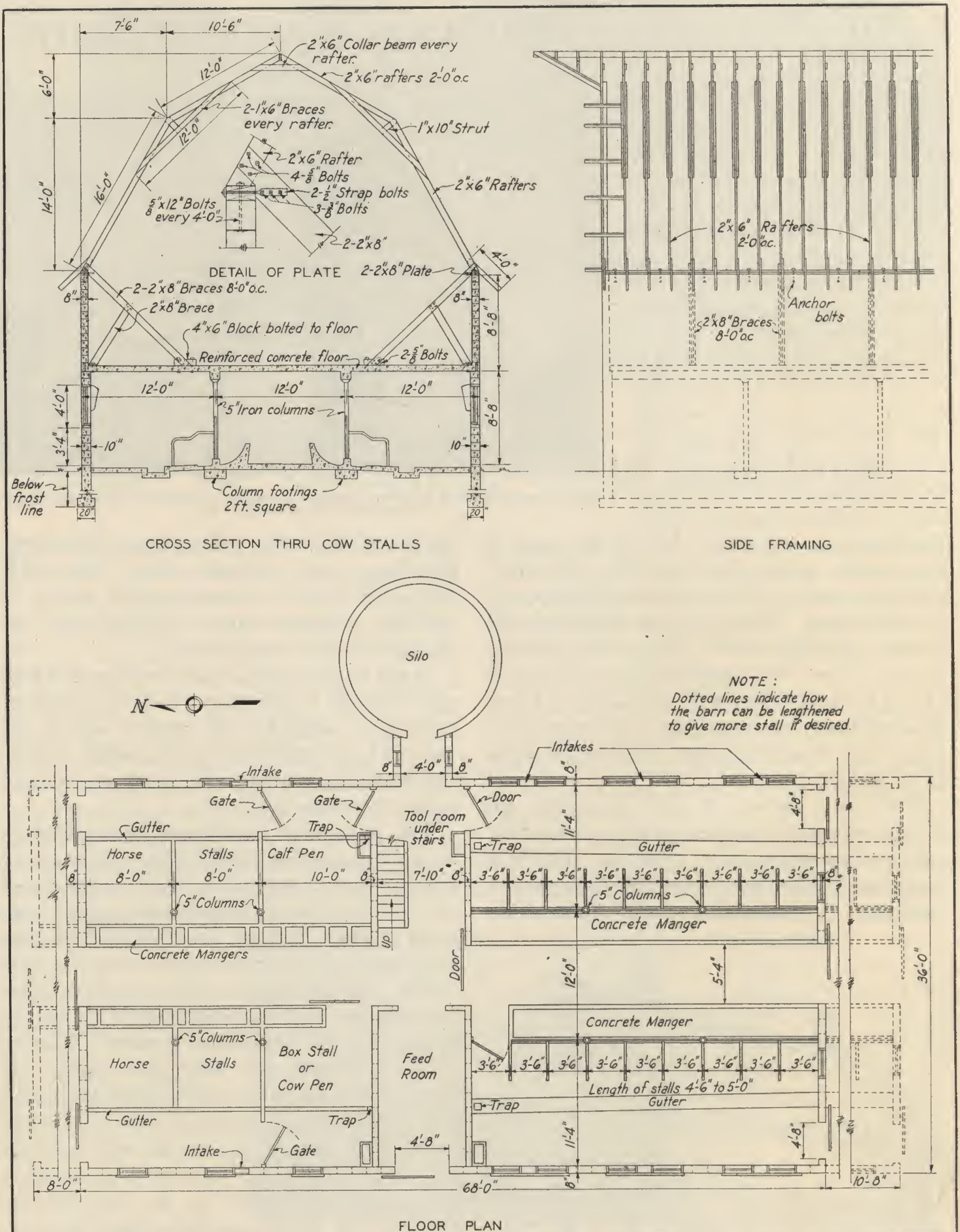
Walls are shown of concrete block, although concrete building tile or monolithic construction is equally suitable. Each of these types provides permanent, firesafe construction at reasonable cost. First floor walls are 10 inches thick; those above the loft floor level 8 inches thick. The gable ends are given a weatherproof armor of portland cement stucco applied over expanded metal or wire fabric.

Perspective. (Drawing C-1361, Sheet No. 1)

If the barn can be located so that the long axis extends north and south, a maximum amount of sunlight will enter it during the day. Horse stalls are in the north end of the building, leaving the south or warmer section for the cows.

The reinforced concrete floor detailed on page 12 illustrates the loft floor construction for this barn. A concrete floor is well worth the additional cost, often insuring expensive stock against loss by fire. Dust from the haymow cannot sift through a concrete slab.

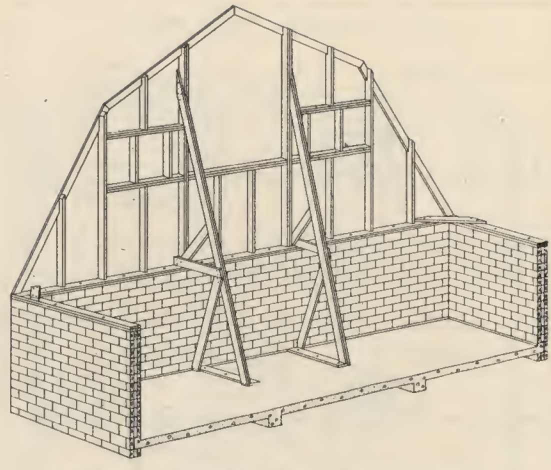
The roof framing is put into place after the masonry wall has been carried to the full height and has had time to harden. Wooden plates to which roof framing is spiked are fastened on top of the wall with bolts placed at not over 6-foot intervals. In monolithic walls the bolts are set in the wet concrete and left projecting; in concrete masonry walls, bolts are placed in the cores of the block or tile, which are then filled with mortar. To resist the outward thrust of the rafters, braces are provided which tie the



Plans for general purpose barn. (Drawing C-1361, Sheets No. 2 and 3)

base of the roof to the loft floor, preventing spreading. These braces are placed before the roof rafters are erected. Rafters adjacent to braces are bolted to them, stiffening the roof framing. (See detail of plate.)

The ceiling in the main portion is 8 feet 8 inches high. Less height would increase the difficulty of operating feed or litter carrier. A greater height would be undesirable, as the increased volume of space would be more difficult to heat. The distance from loft floor to ridge is 28 feet 8 inches, making the barn approximately 38 feet high. The mow capacity is about 80 tons of loose hay. If chopped hay is stored in the loft, columns should be strengthened to meet the heavier floor loading.



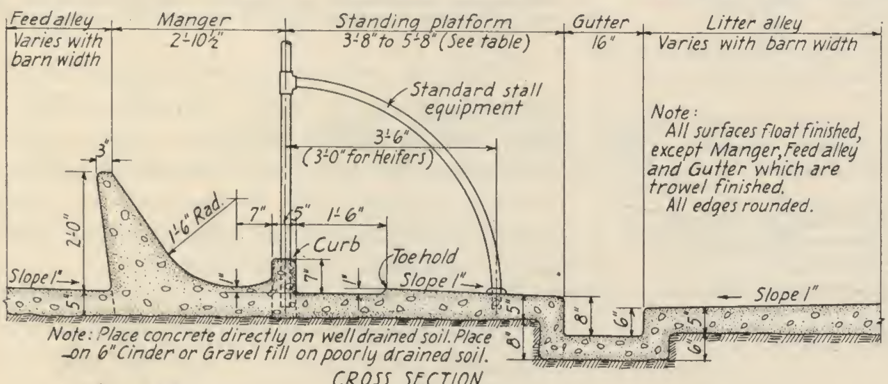
Bracing for gable end of general purpose barn. Use 2 by 8-inch stock. (Drawing B-2177

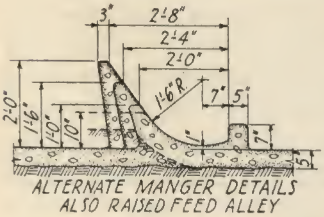
Efficient Dairy Barns

FROM a business standpoint it is important that dairy cows be properly housed. Cold air, foul, damp quarters, excessive humidity, all are obstacles to the production of milk. Some of the feed which animals receive is required to maintain good physical condition. Little of it can go to produce milk if needed to maintain vitality. Clean, light barns, warm against the blasts of winter and cool to counteract the heat of summer, make for increased production and larger profits.

The size of the dairy barn depends upon the number of animals to be housed. It should be planned to permit extensions.

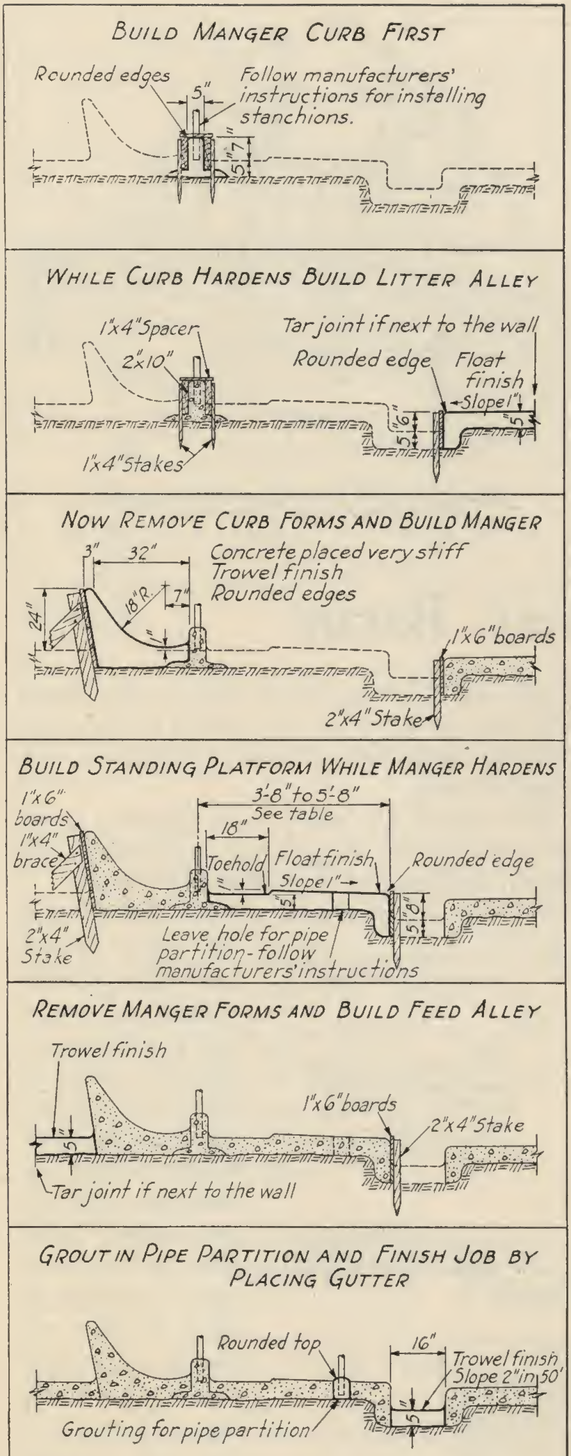
Individual requirements determine whether the barn should be a one, one-and-a-half or two-story structure. Often a one-and-a-half-story building provides sufficient storage for baled hay, but the two-story type may prove the more economical when storage capacity is considered in relation to cost. The cost of the roof is only slightly more on the two-story barn than on the one-





STANDARD STALL DIMENSIONS (For Various Breeds)				
Breeds	Width	Length of Platform		
		Small	Medium	Larger
Holstein	3'-6" to 4'-0"	4'-10"	5'-2"	5'-8"
Shorthorn	3'-6" to 4'-0"	4'-8"	5'-0"	5'-6"
Ayrshire	3'-6" to 3'-8"	4'-6"	5'-0"	5'-6"
Guernsey	3'-4" to 3'-6"	4'-6"	4'-10"	5'-4"
Jersey	3'-4" to 3'-6"	4'-4"	4'-8"	5'-0"
Heifers	2'-9" to 3'-2"	3'-8"	3'-10"	4'-2"

Detail for standard dairy barn floor. (Drawing B-2147)



How to build the dairy barn floor. (Drawing C-2162)

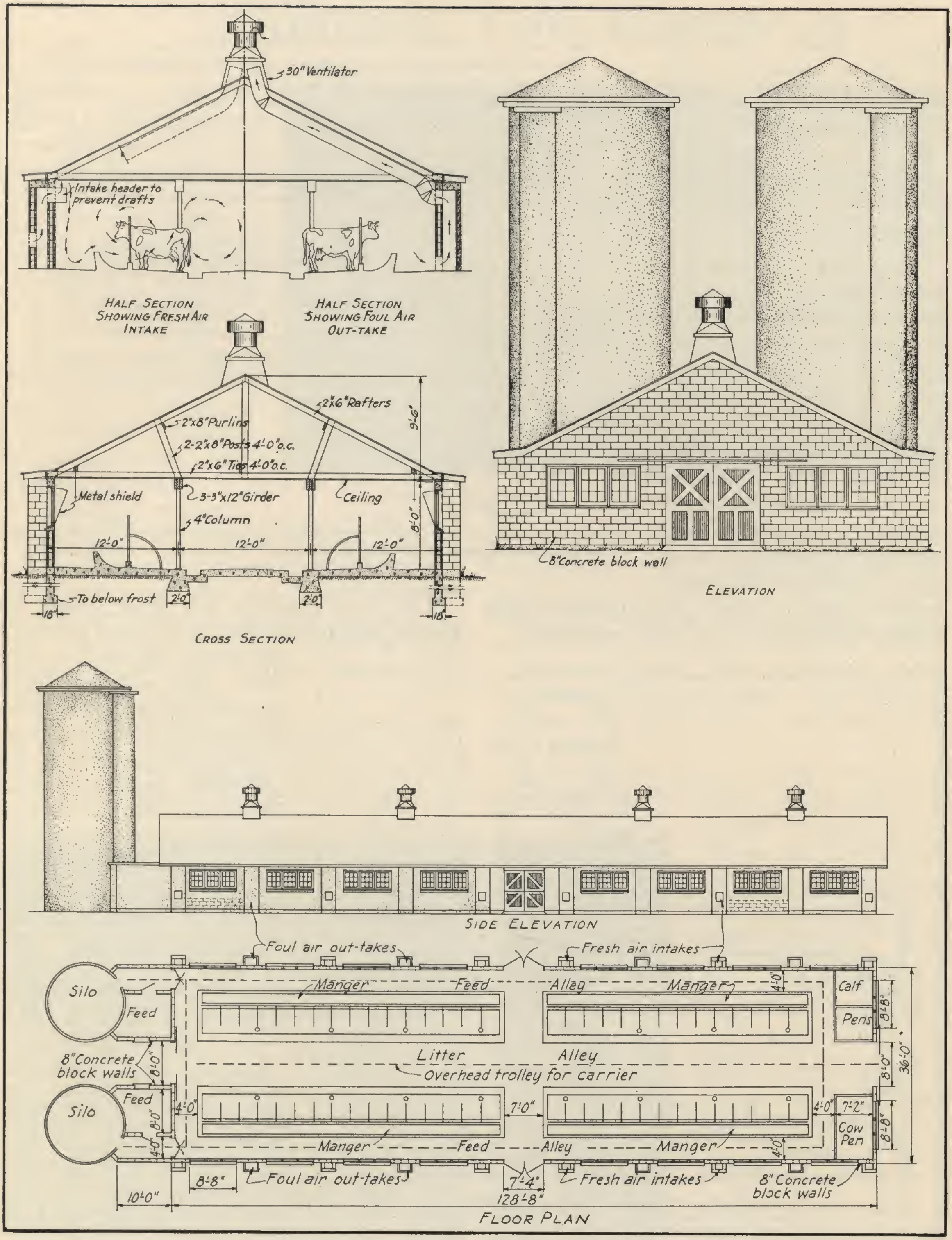
and-a-half-story type and a few additional feet of wall height increases the cost relatively little. In the two-story barn, the roof framing shown on page 6 may be used. It is also suitable for the one-and-a-half-story barn. Roof framing for a one-story barn is shown on page 9.

Proper ventilation of stock quarters requires a continuous change of air and should be given careful consideration. In the accompanying plan, location of flues is suggested, but the size and number will depend upon the number and kind of stock housed. If in doubt, submit proposed barn plans to a specialist in ventilation.

Whether the barn houses a large herd of expensive livestock or only a few cows, concrete provides economy of construction.

Well-built, well-arranged barns lower labor costs of caring for stock. Feed bins placed near feeding points will save many steps. Alleyways should be wide enough to accommodate a silage cart, feed carrier or litter carrier. Hay chutes can be built above feedways. See page 10 for placing silos.

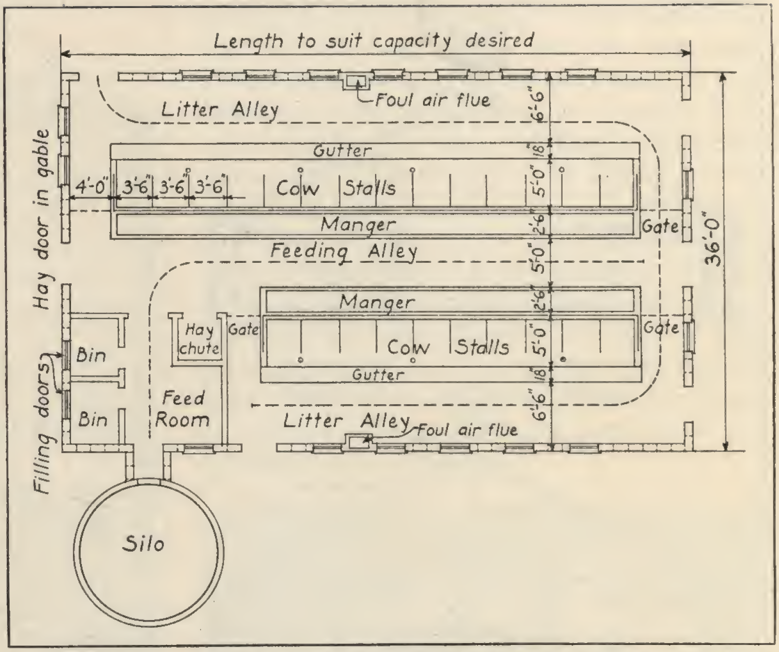
The accompanying typical plans prepared by the American Society of Agricultural Engineers are based on average requirements. The numerous ideas disclosed by the thousands of plans considered by the Society have been, so far as possible, reduced to simple designs, yet providing an arrangement so elastic that any required capacity or size of barn may be built from these typical plans. If a general purpose barn is desired, horse stalls may be built at one end.



Plans for one-story dairy barn. (Drawing C-280, Sheets No. 1 and 2)

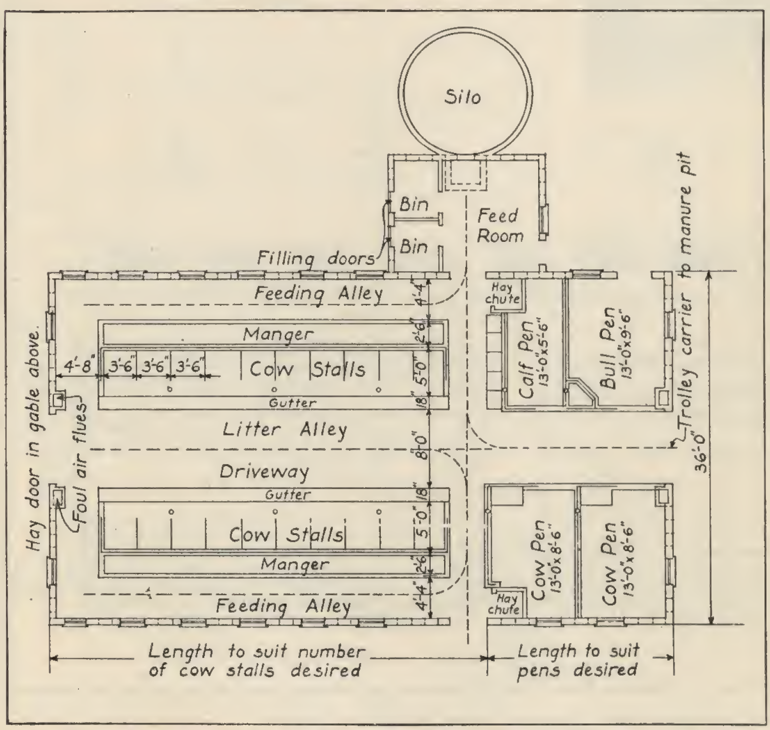
In one plan no cow or calf pens are shown. These may be built on either end of the barn, depending upon its location, and by extending the plan at either end can be made to meet the requirements of a herd of almost any size.

Concrete masonry is recommended for these dairy barn plans, although monolithic concrete is also suitable. Either construction provides economical, firesafe and permanent walls, with surfaces which are easily kept clean and sanitary. Such walls can be washed or disinfected with germicidal solutions if necessary. Concrete walls require neither paint nor repair, thereby eliminating future maintenance and repair expenses.



Standard arrangement for dairy barn with cows facing in. (Drawing B-709)

Use of a concrete loft floor (page 11) should also be seriously considered by every dairyman planning a new barn. Any additional cost that may be incurred by this modern type of construction is more than justified by the additional protection given livestock in the barn in case of a fire in the hay above. In more than one case, a concrete loft floor has saved loss of the dairy herd and the barn equipment.



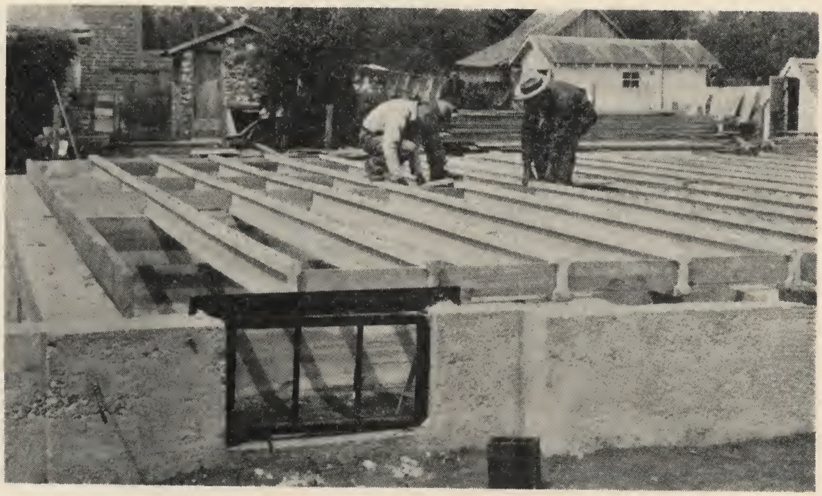
Standard arrangement for dairy barn with cows facing out. (Drawing B-708)

MATERIALS REQUIRED FOR DAIRY BARN FLOORS

Each 100 square feet of floor (standing platform, gutter, feed alley and litter alley), based on slab 5 inches thick and 1:2¼:3 mix, requires approximately 10 sacks cement, 1 yard sand and 1¼ yards pebbles.

Each 10 lineal feet of manger and curb of standard construction (manger front 24 inches above feed alley) requires approximately 8 sacks cement, ¾ yard sand and 1 yard pebbles.

Concrete Loft Floors



Placing precast joists for firesafe concrete first floor of a home.

FIRES in a barn loft are usually disastrous to livestock housed below, unless the animals are protected by a firesafe floor. Frequently, firesafe loft floors have stopped fires while animals were led to safety.

Purebred animals developed by years of careful selection and breeding cannot be replaced by insurance. Besides, insurance covers only part of the loss.

In addition to protection afforded to livestock, a firesafe concrete loft floor protects expensive barn equipment and grain or feed that may be stored below. Except for fires of unusual severity, only the roof will require rebuilding following a loft fire in a barn which has a properly constructed concrete haymow floor.

The concrete floor shown on page 12 is designed for a barn 36 feet wide and for a loft loading of 100 pounds per square foot. Column spacing is 10 feet 6 inches, or the equivalent of three average dairy stalls. Construction of the forms, bending and placing of steel and placing of the concrete for floors involve construction problems requiring the supervision of an experienced builder.

For barn floors of different loading, width, or column spacing, it would be well to engage a contractor experienced in reinforced concrete design.

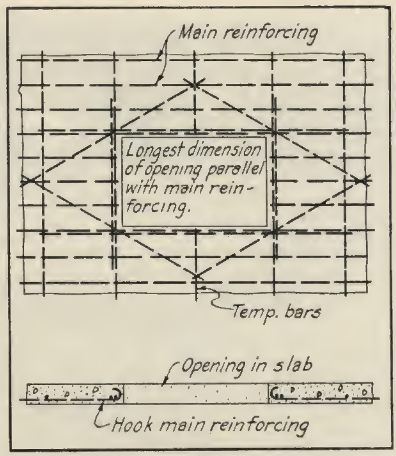
A recent development which further reduces the cost of firesafe concrete floors is precast concrete joists. These joists are usually a modified I-beam shape, 8, 10 or 12 inches deep—depending upon the load to be carried—and 3 to 4 inches wide. The joists are made to the desired span lengths by experienced manufacturers of concrete products. After the joists are in position for the floor, a reinforced concrete slab is placed on top of them in such a manner that the joists and slab are thoroughly bonded together.

Interior view of large dairy barn with precast joist concrete loft floor.

Forms for placing the floor slab are supported on the bottom flanges of the joists, usually without or with fewer temporary columns or "shoring" commonly required to support forms for concrete floors.

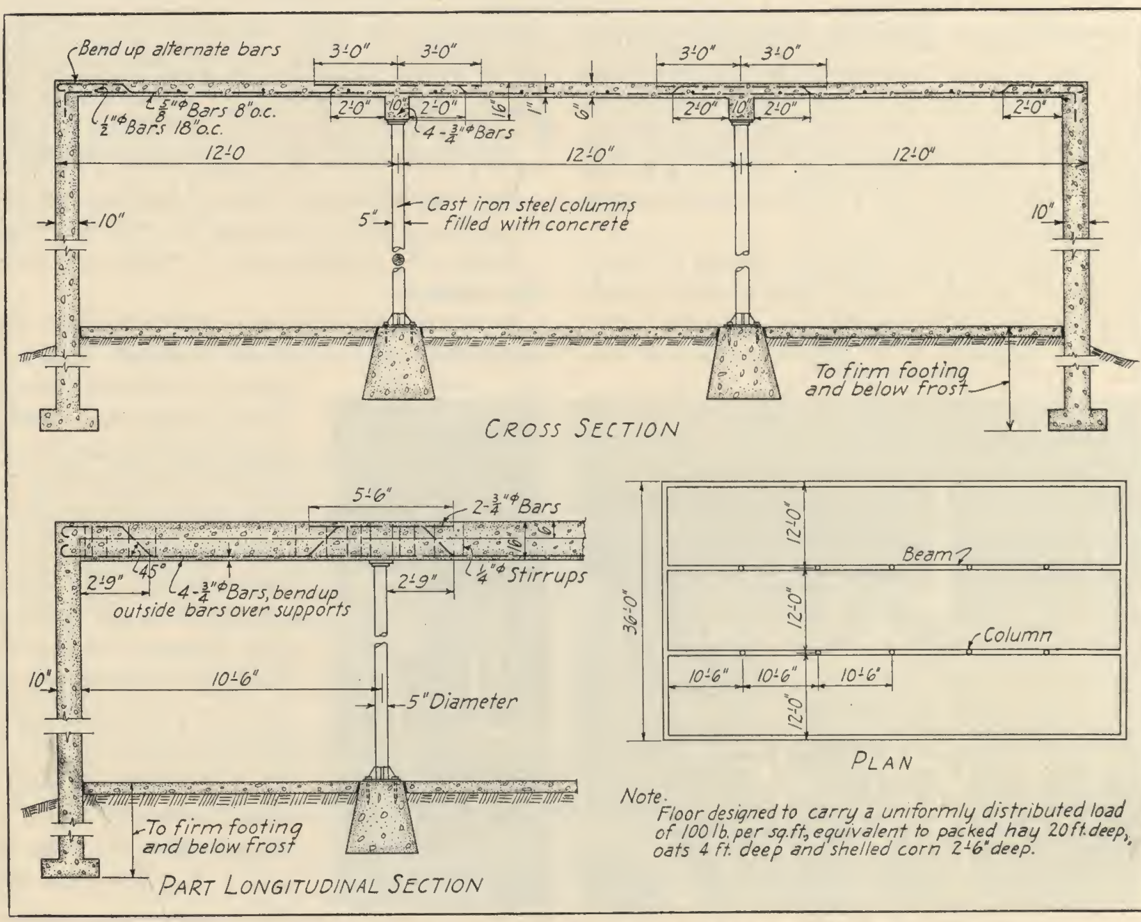
This simple type of form work is one of the major reasons for the economy of precast joist concrete floor construction.

As shown in the illustration on page 11 of a large dairy barn interior, precast joists make an attractive ceiling easy to keep clean and sanitary. The concrete floor slab prevents dust from settling down from the hay above, thus solving one of the important problems for dairymen who are selling milk or cream under city or creamery milk ordinance requirements.



Method of reinforcing around openings in concrete floor. (Drawing A-2179)

Precast concrete joists are now available in nearly every part of the country. When using this type of barn loft construction, the recommendations of the manufacturer or an experienced builder should be followed as to size and span of the joists to meet the loading they will be required to carry.



Plans for firesafe concrete loft floor. (Drawing C-1361, Sheet No. 4)

A Cool, Sanitary Milk House

THAT concrete provides the essential qualities for a farm milk house is commonly recognized by dairymen and by sanitation authorities. Smooth, hard surfaces of concrete are easily cleaned and do not harbor odors which are likely to taint the milk, or bacteria which cause it to sour.

Provide Adequate Sunlight

Plenty of sunlight is desirable in milk houses; windows equivalent in area to 10 per cent of the floor area are recommended; windows which can be opened to provide ventilation in addition to that secured through metal ventilators in the roof. All windows, doors and ventilator openings are screened.

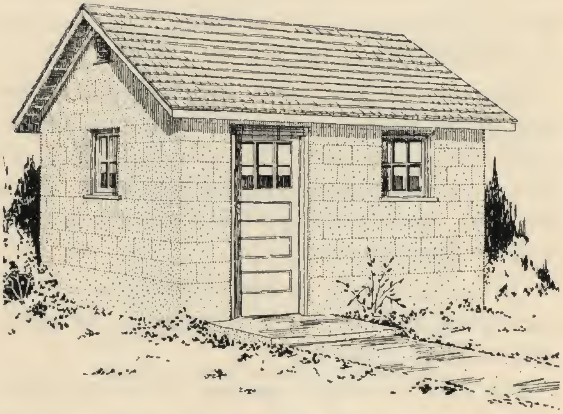
The milk house is purposely made small to avoid the temptation to store miscellaneous tools and implements in it.

Three-room sanitary milk house of concrete masonry.

Construction Information

Instructions for building adequate foundations and watertight floors suitable for the milk house shown are given on pages 52 and 66; plans on page 14. These plans are for a tank of 40 gallons, designed to fulfill the needs of a wholesale dairy producing up to 80 gallons of milk a day.

The capacity of this house can be increased to accommodate 6, 8 or more cans. For each additional pair of 10-gallon cans, increase both the width of the milk room and the length of the tank 2 feet 2 inches. The width of the house is not changed, nor are the dimensions of the wash room. This two-room house will meet the requirements of practically all city milk ordinances.



A milk house is an essential on every dairy farm. Drawing shows exterior of two-room milk house. (Drawing C-2141)

CONCRETE MATERIALS REQUIRED

For a two-room milk house, 12 feet by 14 feet, outside dimensions, use following materials:

Footing and Foundation: Estimate based on 1 part cement, 2¾ parts sand, 4 parts crushed stone or pebbles. Foundation wall assumed to extend 1 foot 7 inches above ground and 2 feet below. Requires 28 sacks portland cement, 3 yards sand and 4 yards pebbles or crushed stone.

Floor and Platform: 5 inches thick. Estimate based on 1:2¼:3 mix. Requires 14 sacks cement, 1¼ yards sand and 1¾ yards pebbles or crushed stone.

Wall: Requires 260 concrete block 8x8x16 inches; 36 corner block 8x8x16 inches; 48 half-block 8x8x8 inches; 86 block 4x8x16 inches; and 20 block 4x8x8 inches.

Mortar for laying block—1 part portland cement, 1 part lime and 6 parts sand. Requires 3½ sacks portland cement, 3½ cubic feet lime and ¾ yard sand.

Mortar for plastering ceiling and base of wall to height of 3 feet 4 inches—1 part cement, 2 parts sand and ¼ part lime. Requires 6½ sacks cement, ½ yard sand and 65 pounds lime.

Milk-Cooling Tanks

Well-constructed milk-cooling tanks save dairymen thousands of dollars annually by providing storage for cooling and holding milk until time for marketing. Without proper cooling facilities, milk soon sours, causing heavy losses.

A reinforced concrete milk-cooling tank may be made either with or without insulation, the insulated tank being recommended when milk is cooled with ice water or by mechanical refrigeration.

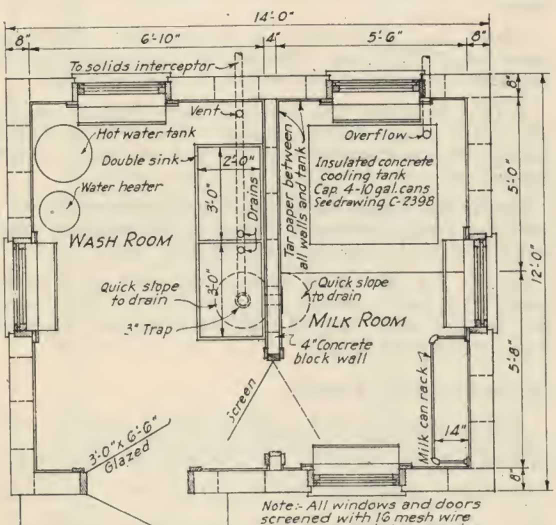
The size of the tank depends upon the number of cans it is to hold plus the necessary cooling water. To obtain rapid, efficient cooling, there should be about three times as much water in the tank as there is milk in the cans.

All tanks should be 40 inches wide and 25 inches deep, inside dimensions. Lengths will vary as follows:

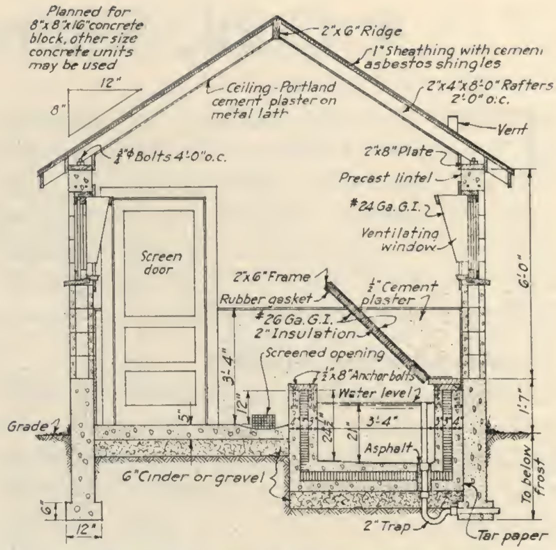
For total storage capacity of 4 cans (10-gallon size), length will be 46 inches, inside dimensions; 6 cans, 72 inches; 8 cans, 98 inches; 10 cans, 124 inches; and 12 cans, 150 inches.

Most dairymen locate the tank against one wall of the milk room. Labor of lifting cans is made easier and insulation improved when the tank is placed partly below the floor level.

Excavation should be slightly larger than the outside dimensions of the tank to allow room for setting the forms. The hole is dug 2 feet 5 inches below the top of the finished floor.



Floor plan of two-room milk house. (Drawing C-2141)



Cross-sectional view of two-room milk house. (Drawing C-2141)

Overflow and Drain

Fittings for overflow and drain are set so that the top of the coupling is flush with the finished floor in the tank. A good location for the overflow pipe is in the middle of one end, about 5 inches from the inside wall.

Constructing Base Slab

A fill of cinders, gravel or coarse sand 6 inches deep, tamped to make an even, firm base, is recommended. Concrete is placed 4 inches thick, the fairly stiff mix being carefully leveled to provide an even surface.

Placing Insulation

Corkboard or other prepared insulating material 3 inches thick is used. Several manufacturers now furnish packages of waterproofed insulation, usually 28 inches wide, 52 inches long and 3 inches thick. A 4-can tank requires 6 packages, 2 for the floor and 4 for the walls. A 6-can tank requires 8; an 8-can, 10; a 10-can, 12; and a 12-can, 14 packages.

Package insulation is also made in units 18 inches wide by 36 inches long and in half sizes for concrete milk cooling tanks. When using this size insulation package, the insulation in the side walls extends below the insulation in the bottom of the tank, and the

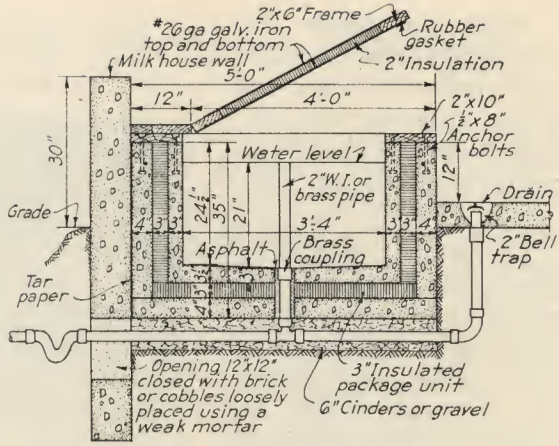
concrete floor of the tank is made 8 inches thick. This method of placing the insulation enables use of standard packages without cutting.

Floor insulation is placed first, being laid on the concrete base. A hole is cut in the package placed over the drain pipe, leaving a ½-inch opening all around the pipe to be filled with hot asphalt. Packages for end and side walls are erected next.

When package insulation is not available, use corkboard 3 inches thick, which comes in pieces 1 foot wide and 3 feet long. Cork must be kept dry. Cut it to fit and then mop it with hot asphalt, covering all surfaces. Edges are painted again with hot asphalt when the pieces are fitted together. As a further precaution to keep out moisture, corkboard is covered with a woven cotton fabric and again mopped with hot asphalt.

Forms for Wall

Forms are made of 1-inch dressed and matched lumber stiffened with 2x4-inch studs and are erected after insulation is in position. Faces of inner and outer forms are held 10 inches apart with 4-inch long wood blocks between outer form and insulation; 3-inch blocks between insulation and inner form face. Blocks are removed as concrete is placed. Where the tank extends entirely across the end of the milk house the foundation wall serves as the outer form on the ends and one side of the tank. In this case, place tar paper against the foundation to separate the tank and the wall. Form faces should be lightly oiled.

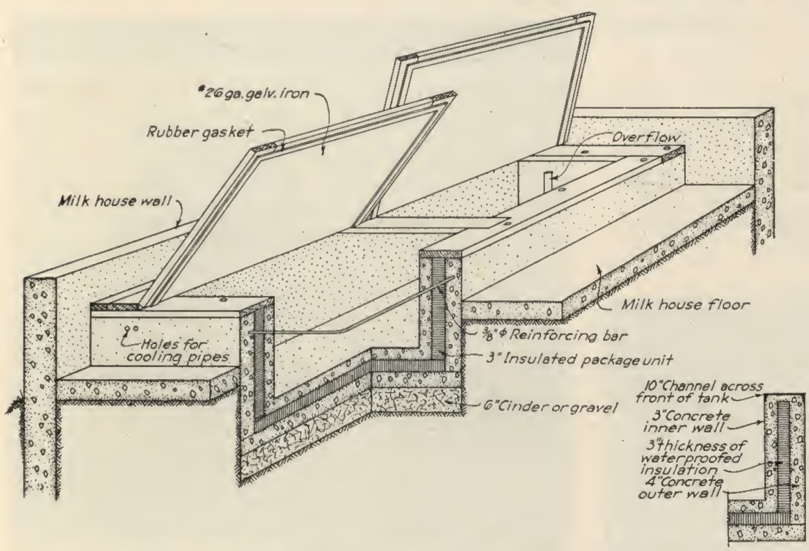


Cross-section of insulated cooling tank. (Drawing C-2398)

Mixing and Placing Concrete

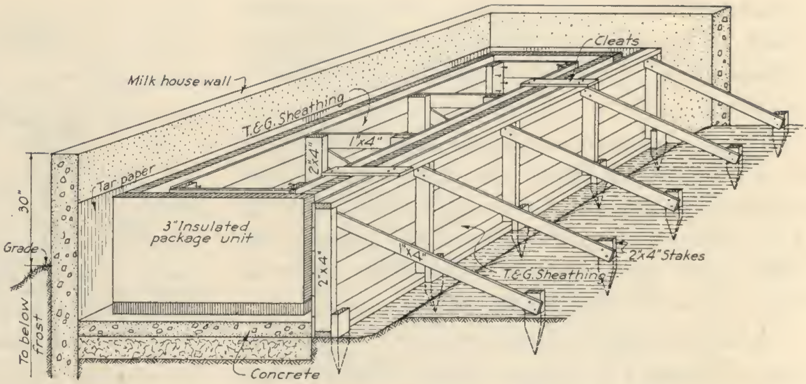
The recommended proportion is 5 gallons water for one sack of cement. (See Table I, page 52.) Place floor first, sloping it slightly toward the drain. Place a tin collar around the drain, leaving a ½-inch space. After the concrete hardens, remove this collar and fill space with hot asphalt.

Concrete for the walls is placed in the forms in layers 4 inches deep, care being taken to fill both the inner and outer walls to the same depth in order not to move the insulation. Spade the concrete as it is placed. When forms are filled to within 4 inches of the top, place a ⅜-inch reinforcing bar in the center of the outer wall, extending around the tank. Lap all splices 15 inches.



Perspective of cooling tank. Corner cut-out shows construction. At right, alternate design for rim of tank. (Drawing C-2398)

When the forms are completely filled, ½x8-inch anchor bolts are set 2 feet apart in the concrete, with threaded ends projecting about 1¾ inches.



Forms for building walls of insulated tank. (Drawing C-2398)

In warm weather, forms usually can be removed in 24 hours. More time should be allowed in cool weather. After forms are removed, inside of tank is painted with a wash of portland cement and water. The concrete is cured by covering tank with burlap and keeping it moist for 7 or more days, depending on the temperature.

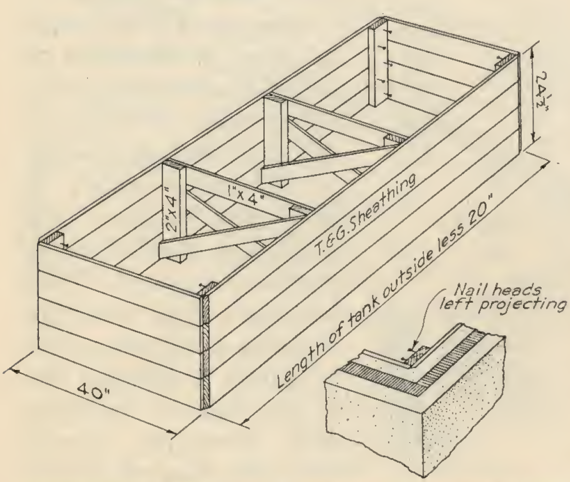
After the concrete has hardened, the plate or rim, consisting of 2x10-inch planks, is attached to anchor bolts. A thin bed of mortar (1 part portland cement and 2 parts sand) is spread over the top of the wall. Nuts on the anchor bolts are counter-sunk in the plate. Sometimes a channel iron rim is placed across the front of the tank to protect it.

Insulated Cover

The cover consists of a 2x6-inch framework filled with a 2-inch thick insulation and covered on the top and bottom with 26-gauge galvanized sheet metal. Rubber gaskets are tacked around the edges of the cover to seal all joints. Covers for tanks 8 feet or more in length are built in two sections for greater ease in opening.

First Cost Is Last Cost

The well-made concrete milk-cooling tank will last indefinitely, without need of repair and upkeep expense. It will not rot nor rust. It is easy to keep clean and sanitary. The investment in a concrete cooling tank will continue to pay dividends year after year in higher quality dairy products, less spoilage and in easier, quicker handling of milk and cream.



Perspective of inner form. Lower right, detail showing construction of corner of form. (Drawing C-2398)

A concrete milk-cooling tank requires a minimum of heavy lifting when handling milk and cream cans.

Essentials of Poultry House Design

POULTRY houses correctly designed and built are vitally important to the success of every poultry enterprise regardless of size. While poultry houses should always be comparatively simple in design, they must meet certain definite conditions if they are to prove genuinely practical.

Regardless of size, every such building should provide not only for the comfort and well-being of the fowls but also for the convenience of the caretaker. Proper housing of the fowls includes dry, well-ventilated and highly sanitary quarters and adequate protection against rats, weasels and other rodents. Mites and lice must not be harbored in the floors and walls of the building if such pests are to be eradicated. Adequate protection against fire is desirable.

Concrete offers all these qualities. Prominent poultry authorities agree that concrete is unequaled for the floor of the poultry house. Earth floors are insanitary, dusty. Unless the top layer is replaced each year with fresh soil it becomes heavily infected with disease organisms. Concrete floors are easily kept sanitary and require the minimum of attention. In the long run they are the most economical. Concrete floor construction is described on page 66. As an added precaution in securing an absolutely dry floor, some poultrymen recommend laying a thickness of tar paper over the earth before placing concrete.

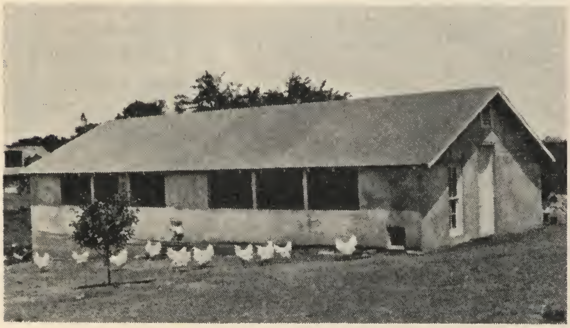
How Large to Build the Poultry House

Where the flock is out-of-doors a considerable portion of the time, 2½ to 3 square feet of floor space is usually provided for each bird. For flocks that are kept in the house most of the time, 4 to 5 square feet is ordinarily recommended.

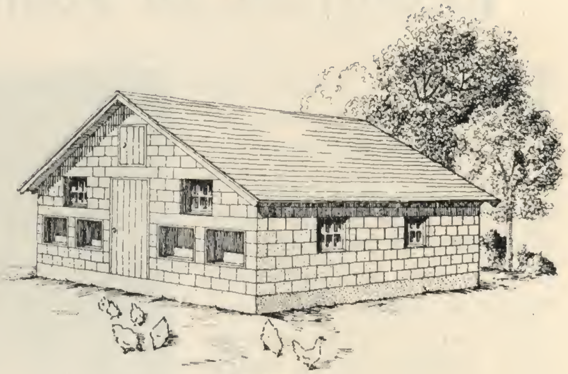
Overcrowding of roosts is avoided when 8 to 10 inches of roost space is allowed each bird. Perches are ordinarily placed about 12 inches apart. One nest about 15 inches square is usually provided for each four hens. Nests are placed according to individual preference.

Location

A high or well-drained location, sheltered from cold winds, is most desirable. Whenever possible, the house should be faced toward the south, then maximum sunlight is secured and the house is warm, dry and cheerful, resulting in increased egg production and a healthy poultry flock.



STRAW LOFT POULTRY HOUSE

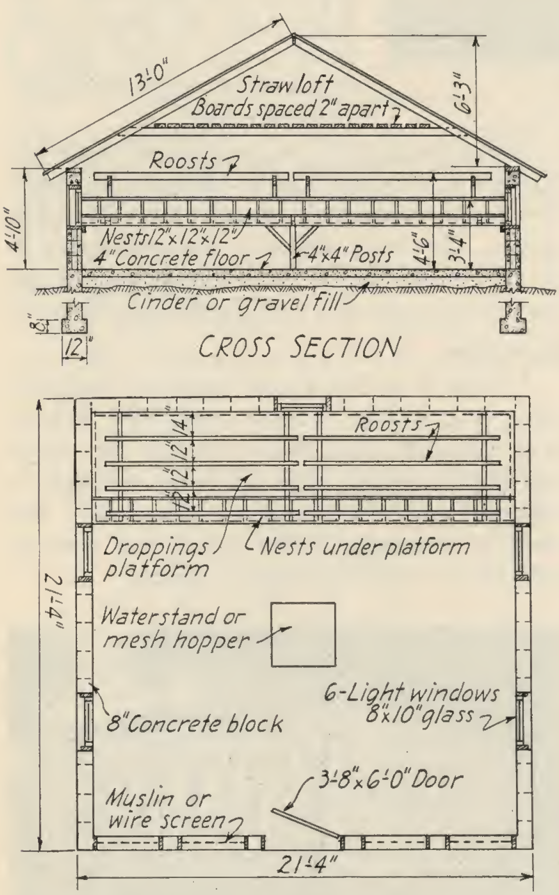


Perspective

THE open front poultry house shown here was designed to meet requirements for a flock of 100 to 150 birds. For larger flocks a larger house of the same general design is built. A house with 30 feet by 30 feet inside dimensions will accommodate 250 to 300 hens. Then six openings covered with wire are used in the south wall instead of the four shown. In a large house it is customary to place two rows of nests under the roosts. Then the roosts and dropping boards are moved out far enough from the rear wall to provide a passageway for access to the back row of nests.

The straw loft house, when well constructed, is designed to maintain uniform temperature conditions. The 2-foot layer of straw prevents the rapid escape of heat in winter, and the lower ceiling lessens the number of cubic feet of air space that has to be warmed by heat given off by the birds. The straw also acts as insulation against heat from the sun in summer.

Concrete masonry construction is especially suitable for open front poultry houses, since the success of this type of house in winter months depends upon airtight walls for east, west and north sides of the house.



Plan and cross-section of straw loft poultry house. (Drawing B-1789)

MATERIALS REQUIRED

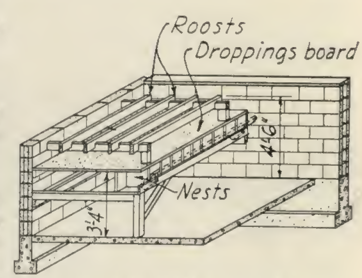
(20 feet by 20 feet inside dimensions)
Drawing No. B-1789

Footing and Foundation: Foundation wall assumed to extend 1 foot above ground and 2 feet below, with footing underneath. Estimate based on 1:2¾:4 mix for footing and 1:2¼:3 mix for foundation. Requires 48 sacks cement, 4½ yards sand and 5¾ yards pebbles.

Floor: 4 inches thick. Estimate based on 1:2¼:3 mix. Requires 31 sacks cement, 2¾ yards sand and 3½ yards pebbles.

Wall: 8 inches thick. Requires 400 concrete block and 24 corner block 8x8x16 inches; 43 half-block 8x8x8 inches; and 2 half-corner block 8x8x8 inches. If wall is built of concrete building tile instead of block, 950 units 5x8x12 inches will be required. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 3 sacks cement, 3 cubic feet lime and 18 cubic feet sand for mortar for block. For tile, 1½ times these amounts.

If wall is constructed of monolithic concrete (1:2¼:3 mix) in place of masonry, 68 sacks cement, 5¾ yards sand and 7½ yards pebbles will be needed in addition to that required for floor and foundation.



Detail of nests and roosts. (Drawing B-1789)

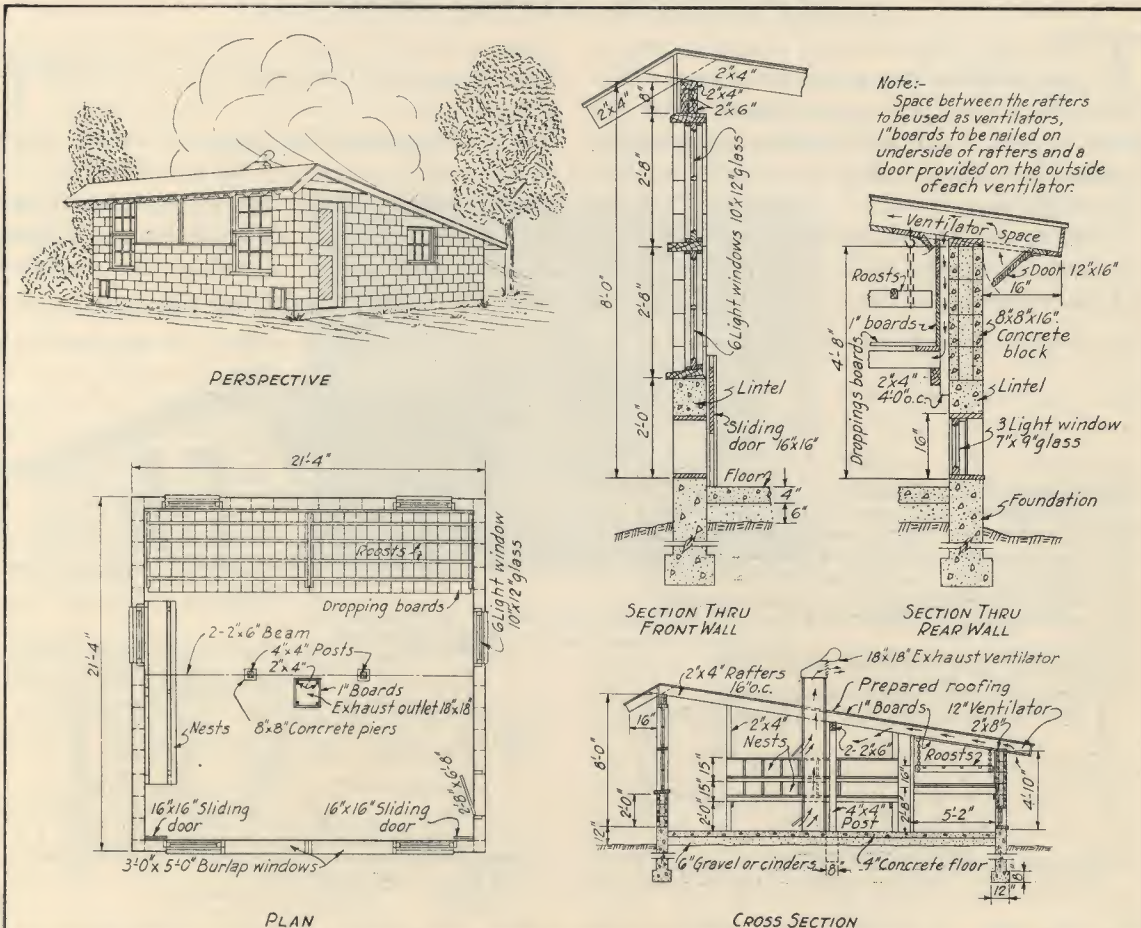
SHED ROOF POULTRY HOUSE

MID-WESTERN poultry raisers have developed a unit system house which is readily enlarged by adding 20-foot sections. The special ventilating feature of this house shown in the cross-section makes tight concrete walls highly desirable as infiltration of air through the walls would reduce the efficiency of the ventilation system. Windows on all four walls insure even distribution of litter on the floor since hens when scratching normally face the light.

The arrangement and construction of this house, which will accommodate from 100 to 125 birds, are such that time is saved for the caretaker and warm, dry, healthful quarters are secured for the fowls—conditions which are essential if the flock is to return a profit.

The shed roof design makes a practical, economical poultry house for the small or medium size flock.

In the northern sections of the country it is desirable to insulate the roof. Insulation prevents loss of heat in winter and



Plans for Mid-western Shed Roof poultry house. (Drawing C-1772)

greatly increases the efficiency of the ventilation system. Note that the outlet flue for foul air extends down to about a foot above the floor. In this way, rapid loss of air heated from the bodies of the birds is prevented, but the air is changed often enough to keep the air pure and dry.

MATERIALS REQUIRED

(20 feet by 20 feet inside dimensions)
Drawing No. C-1772

Footing and Foundation: Estimate based on 1:2¾:4 mix for footing and 1:2¼:3 mix for foundation. Foundation wall assumed to extend 1 foot above and 2 feet below ground with footing underneath. Requires 48 sacks cement, 4½ yards sand and 5¾ yards pebbles.

Floor: 4 inches thick. Estimate based on 1:2¼:3 mix. Requires 31 sacks cement, 2¾ yards sand and 3½ yards pebbles.

Wall: Requires 363 concrete block 8x8x16 inches; 32 corner block 8x8x16 inches; 33 half-block 8x8x8 inches; and 2 half-corner block 8x8x8 inches.

A good beginning for a good poultry house. Careful experiments have proven the many desirable advantages of concrete poultry house floors.

If built of concrete building tile instead of block, 845 units 5x8x12 inches will be required. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 2¾ sacks cement, 2¾ cubic feet lime and 16½ cubic feet sand for mortar for block. For tile 1½ times these amounts.

If walls are built of monolithic concrete (1:2¼:3 mix) instead of block or tile, 63 sacks cement, 5¼ yards sand and 7 yards pebbles will be needed in addition to that required for floor and foundation.

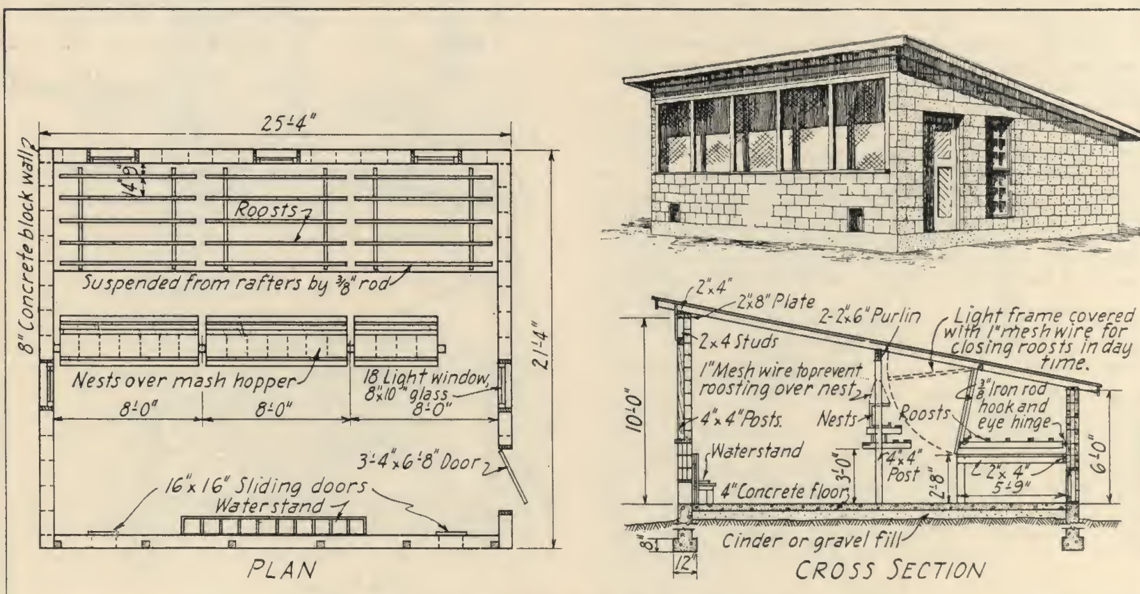
OPEN FRONT LAYING HOUSE

THE open front laying house shown is successful in the southern states. This front which occupies more than half of the south exposure admits fresh air and sunlight in abundance, providing thoroughly healthful conditions.

Concrete floors are highly desirable in those sections where the stick-tight flea is found.

Low windows in the north wall light the space under the roosts, and thus increase the floor space that fowls will use as a scratching area.

The accompanying plans show an open front poultry house 20 by 24 feet, to accommodate about 150 birds. For larger flocks, the house can be made longer, adding on in 12-foot units. The concrete masonry walls will aid in keeping the house at a



Plans for open front laying house. (Drawing B-1790)

comfortable temperature in hot summer days. Additional coolness can be secured by insulating the roof.

MATERIALS REQUIRED

(20 feet by 24 feet inside dimensions)
Drawing No. B-1790

Footing and Foundation: Estimate based on 1:2¾:4 mix for footings and foundation. Foundation wall assumed to extend 1 foot above ground and 2 feet below. Requires 53 sacks cement, 5 yards sand and 6½ yards pebbles.

Floor: 4 inches thick. Estimate based on a 1:2¼:3 mix. Requires 38 sacks cement, 3¼ yards sand and 4¼ yards pebbles.

Wall: Requires 395 concrete block 8x8x16 inches; 44 half-block 8x8x8 inches; 38 corner block 8x8x16 inches; and 10 half-corner block 8x8x8 inches. If wall is built of concrete building tile, 980 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 3 sacks cement, 3 cubic feet lime and 18 cubic feet sand for mortar for block. For tile 1½ times these amounts.

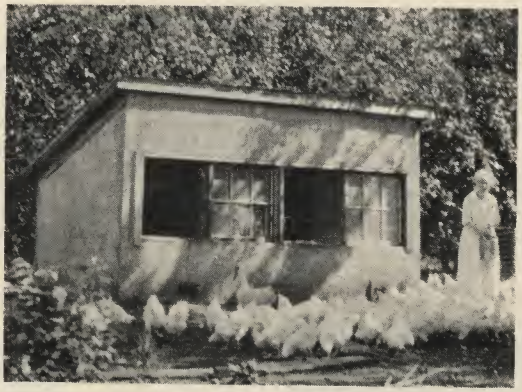
If built of monolithic concrete (1:2¼:3 mix) instead of masonry, 68 sacks cement, 5¾ yards sand and 7½ yards pebbles will be needed in addition to that required for the floor and foundation.

Poultry house walls built of concrete masonry units eliminate drafts and thereby promote the good health of the flock.

CONCRETE COLONY BROODER HOUSE

THE size of the brooder house is determined by the number of chicks to be brooded and the source of heat used. One square foot of floor space is usually recommended for every four chicks.

The house shown in the drawing on page 22 provides ample quarters for 250 to 350 small chicks. When chicks are old enough to fly, perches may be placed in the notches cut in the 2x3-inch roost supports shown.



Fire hazard from brooder stoves is reduced by concrete construction and the house is easily kept sanitary.

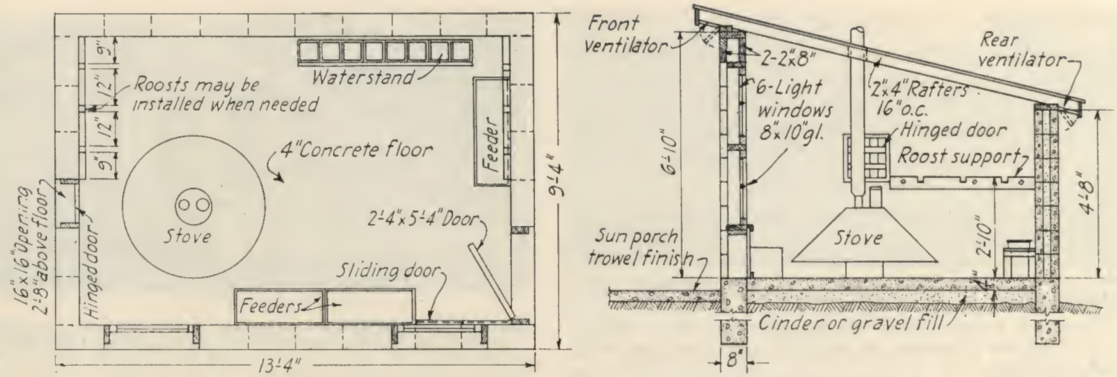
Concrete floors and walls are especially desirable for brooder houses as they exclude rats and other pests and are easily cleaned.

Sun Porch for Chicks

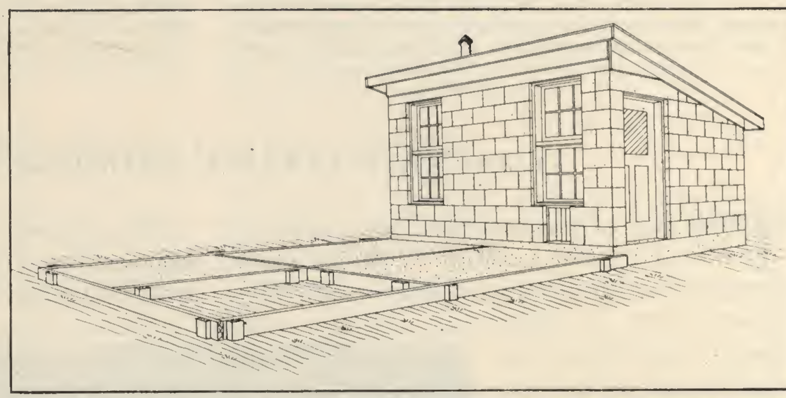
After three years' trial in several eastern states the "concrete sun porch," hard-surfaced exercising yard for chicks, has been pronounced practical and a money-maker.

The pavement protects the health of growing chicks by keeping them off contaminated ground during their first few weeks, during which they are susceptible to coccidiosis, blackhead, and intestinal worm infection—profit-taking diseases commonly spread in droppings. On such outdoor platforms the chicks get direct sunlight. The congestion within the house is also relieved. The young chicks gradually become accustomed to outdoor air so that the change from the constant heat of the brooder stove is less abrupt.

Since a concrete platform can be cleaned thoroughly, the poultryman is saved the expense of continually moving the house and yard to new, uncontaminated areas—an essential sanitary practice when chicks are allowed to run on the ground.



Plan and cross-section of concrete colony brooder house. (Drawing B-1791)



Perspective view of brooder house showing placement of forms for building concrete sun porch for growing chicks.

MATERIALS REQUIRED

(8 feet by 12 feet inside dimensions)
Drawings No. B-1791 and B-1803

Foundation: Estimate based on 1:2¾:4 mix. Foundation wall assumed to extend 2 feet below and 1 foot above ground. Requires 15½ sacks cement, 1¾ yards sand and 2½ yards pebbles.

Floor: 4 inches thick. Estimate based on 1:2¼:3 mix. Requires 7½ sacks cement, ¾ yard sand and 1 yard pebbles.

Sun Porch Floor: Based on 1:2¼:3 mix. For each area 10 feet by 13 feet 4 inches, 10½ sacks cement, 1 yard sand and 1¼ yards pebbles are required.

Wall: 8 inches thick. Requires 166 concrete block 8x8x16 inches; 28 corner block 8x8x16 inches; 24 half-block 8x8x8 inches.

If wall is built of concrete building tile instead of block, 436 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 1½ sacks cement, 1½ cubic feet lime and 9 cubic feet sand for mortar for block. For tile 1½ times these amounts.

If wall is built of monolithic concrete instead of block or tile (1:2¼:3 mix), 30 sacks cement, 2½ yards sand and 3½ yards pebbles will be needed in addition to that estimated for foundation and floor.

Concrete Floors for Poultry Houses are Recommended by Experiment Station

"In planning a poultry house, keep in mind the necessity to develop and maintain normal health and activity of the fowls kept within it. In other words, it must furnish a thoroughly sanitary and healthful environment.

"The floor is a very important part of the poultry house, especially from the standpoint of maintaining sanitary conditions. It is important that the floor should be smooth as possible, for this will aid materially in cleaning out the litter from time to time. The *smooth, concrete floor* can easily be swept, washed and disinfected, if necessary."—*Bulletin No. 370,* New Jersey Experiment Station.

Warm, Dry Hog Houses

NO animal on the farm requires more protection from cold and from dampness than the little pig. There is none for which a good bed is so necessary, none so in need of invigorating sunshine. The little pig takes cold easily and recovers slowly, if at all. "To prevent cold," says the United States Department of Agriculture, "he must be kept dry, warm, away from drafts, and provided with fresh air."

Hog raisers who have good warm buildings can have their sows farrow in February or March. Pigs should come early to get them onto the fall market.

One of the best layouts for a modern hog house consists of two rows of pens with central feeding alley or driveway. The width may vary from 20 to 30 feet according to the width of driveway and depth of pens. The length is varied to give the required number of pens. For small herds, the hog house shown with one row of pens and a feeding alley alongside has been found practical.

In selecting the type of hog house to build, the hog raiser should decide on a design that will be easy to ventilate, and one which will be most easily kept warm in winter by heat from the animals' bodies. In general, a house with a low roof will best meet these requirements. There will then be less space to be heated, and less materials are required for construction of the walls.

Use of adequate insulation in the roof should be seriously considered, as proper insulation increases efficiency of the ventilation system, prevents loss of heat in winter and keeps the house cool in summer.

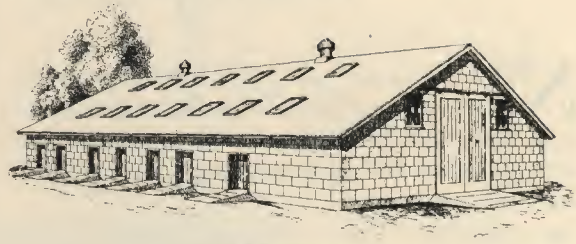
A hog house with concrete floors and walls may be thoroughly cleaned and disinfected with minimum of time and expense and will require a minimum of upkeep expense in years to come. It will form an attractive addition to the farm building layout.

Completing new concrete masonry hog house with feed storage at one end.

A popular, economical type of hog house, built with concrete masonry walls and concrete floors.

THE SKYLIGHT HOG HOUSE

THE skylight hog house, so called because it has skylights in the roof, generally is located with the long way of the house north and south. Then the morning sun strikes the west row of pens and the afternoon sun the east row. The windows are usually hinged so that they can be opened for ventilation.



Perspective

MATERIALS REQUIRED

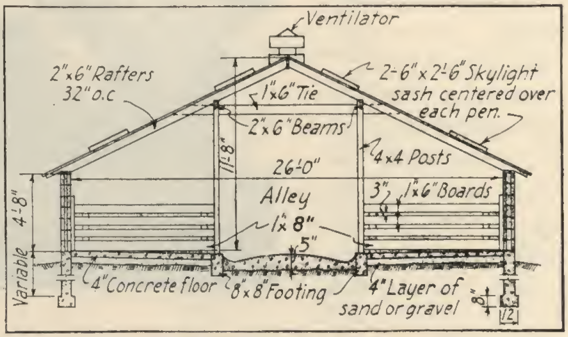
(50 feet by 27 feet 4 inches outside dimensions)
Drawings No. C-2087 and B-2170

Footings and Foundation: Estimate based on 1:2¾:4 mix for footings under outer wall and columns. Foundation to be 1:2¼:3 mix. Foundation wall to extend 2 feet below and 6 inches above ground. Requires 81 sacks cement, 7¼ yards sand and 10½ yards pebbles.

Floor: Estimate based on 1:2¼:3 mix. Requires 110 sacks cement, 9¼ yards sand and 12¼ yards pebbles.

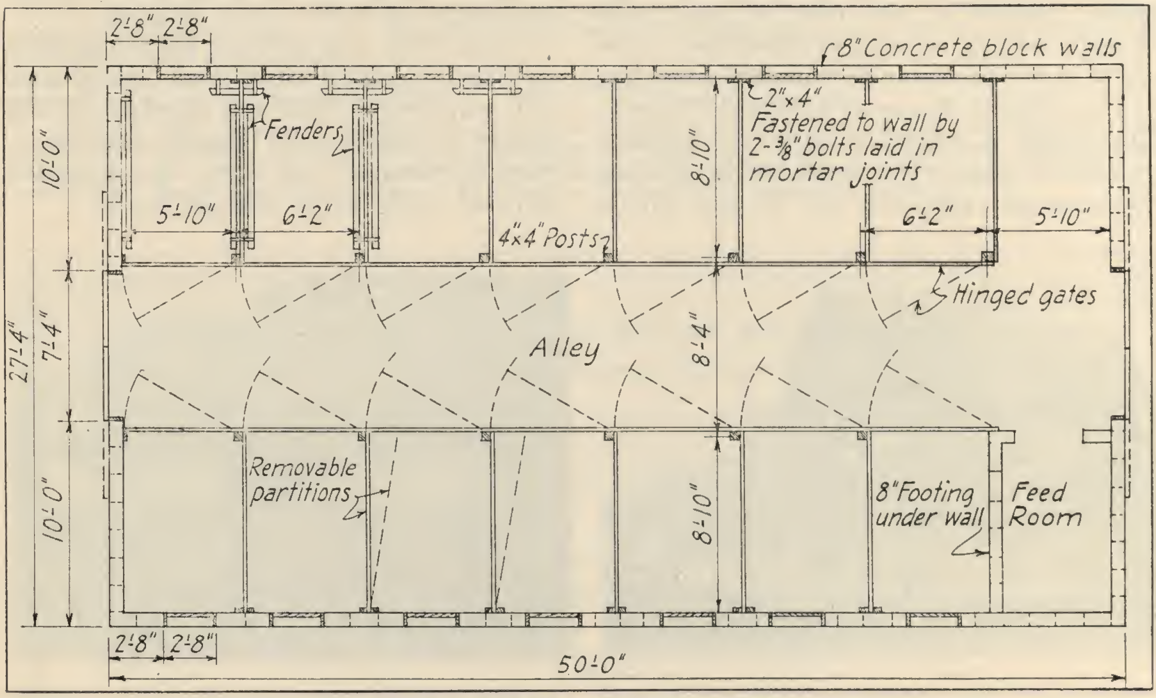
Wall: 8 inches thick. Requires 681 concrete block 8x8x16 inches; 37 corner block 8x8x16 inches; and 146 half-block 8x8x8 inches. Requires 8 sacks cement, ¾ yard sand and 1 yard pebbles for lintels over doors and windows, using 1:2¼:3 mix.

If wall is built of concrete building tile instead of block, 1675 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 5¼ sacks cement, 5¼ cubic feet lime and 1¼ yards sand for block. For tile, 1½ times these amounts.



Cross-section. (Drawing C-2087)

If wall is built of monolithic concrete (1:2¼:3 mix) instead of block or tile, 115 sacks cement, 9¾ yards sand and 12¾ yards pebbles will be needed in addition to the amount estimated for foundation and floor.



Plan of skylight hog house. (Drawing C-2087)

SUNSHINE HOG HOUSE

THE sunshine hog house is a variation of the skylight house. It has a gambrel or two-pitched roof which is supported on low walls usually only 3 feet 6 inches high.

This hog house design has the advantage both of being economical to build and easy to keep warm and to ventilate when built. By reducing the length of the pens and widening the building, a central driveway, wide enough to drive through with a team and wagon, can be made.

MATERIALS REQUIRED

(24 feet by 58 feet outside dimensions)
Drawing No. C-2169

Footings and Foundation: Estimate based on 1:2¾:4 mix for footings under walls and columns and 1:2¼:3 mix for foundation walls. Foundation wall to extend 2 feet below and 6 inches above ground. Footings under piers assumed 2 feet deep. Requires 90 sacks cement, 8 yards sand and 12 yards pebbles.

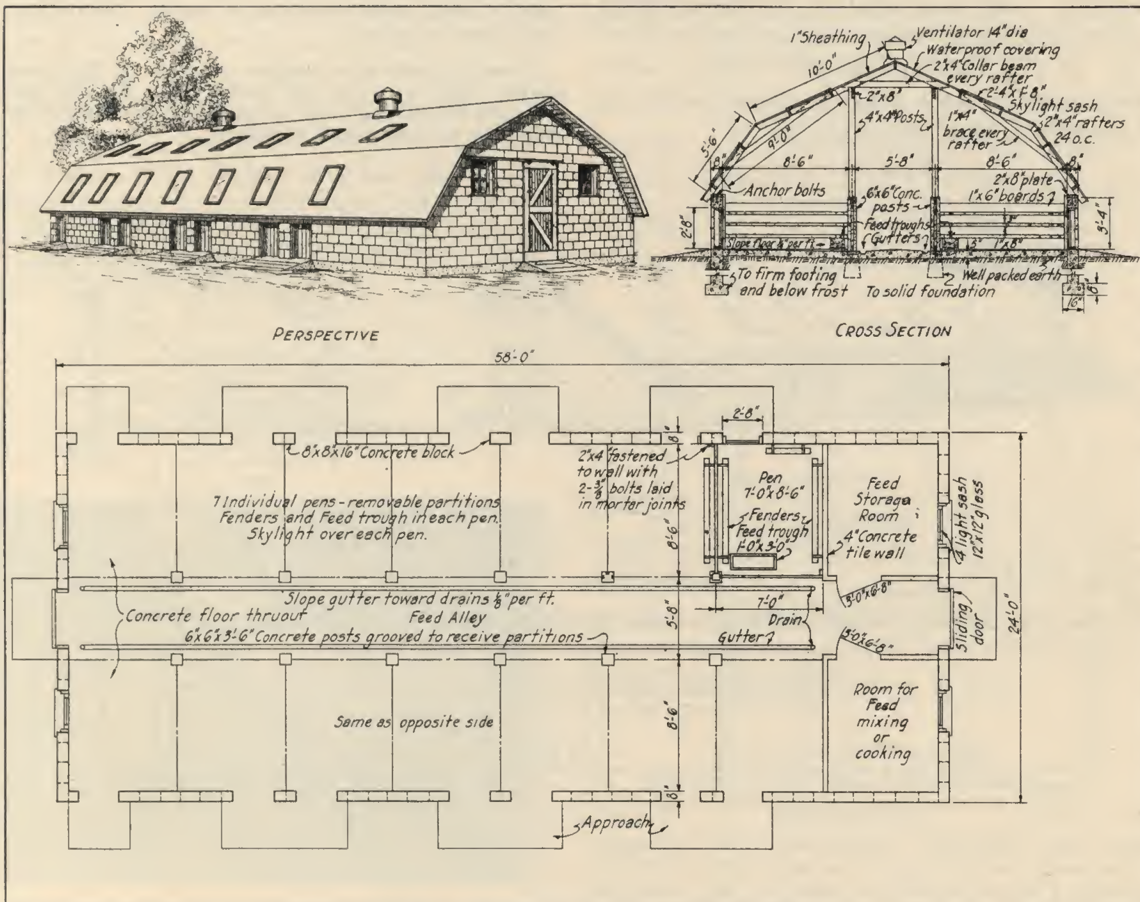
Floors and Approaches: Estimate based on 1:2¼:3 mix. Requires 134 sacks cement, 11¼ yards sand and 15 yards pebbles.

Posts and Troughs: Estimate based on 1:2¼:3 mix. Requires 9 sacks cement, ¾ yard sand and 1 yard pebbles. Requires 378 lineal feet of ¼-inch round reinforcing rods.

Wall: Eight inches thick. Requires 526 concrete block 8x8x16 inches; 20 corner block 8x8x16 inches; and 110 half-block 8x8x8 inches. For interior partition walls, 225 units concrete building tile 4x8x16 inches are needed.

If exterior wall is built of concrete building tile instead of block, 1270 units 5x8x12 inches will be needed. Mortar for laying block, 1 part cement, 1 part lime and 6 parts sand. Requires 6 sacks cement, 6 cubic feet lime and 1¼ yards sand for mortar. For tile wall, 1½ times these amounts needed for mortar.

If wall is built of monolithic concrete (1:2¼:3 mix) instead of block or tile, using 8 inch wall for exterior and 6 inch wall for interior partitions, 113 sacks cement, 9½ yards sand and 12½ yards pebbles will be needed in addition to that estimated for foundation and floor.



Plans for a sunshine hog house. (Drawing C-2169)

SINGLE ROW FARROWING HOUSE

PLANS given below show a farrowing house of moderate cost but possessing all the essentials of the larger type colony hog house. It has warm, tight walls of concrete masonry. Concrete floors provide a high degree of sanitation. This type house is always built with the long way east and west, and the row of pens in the south or warmer side of the building. The pens also open to the south, allowing feeding platform or exercising yard to be located on the sunny side of the building. Roof windows admit plenty of sunlight where it is wanted.

The farrowing pens in this concrete hog house are easily cleaned. There are no cracks and crevices in which dirt can lodge. Concrete floors and walls may be thoroughly disinfected by scrubbing with boiling water and lye. This is a sanitary measure highly recommended by swine sanitation authorities. As a further sanitation measure, a concrete feeding floor may be constructed on the south side of this house.

MATERIALS REQUIRED

(14 feet by 58 feet outside dimensions)
Drawing No. B-2172

Footings and Foundation: Estimate based on 1:2¾:4 mix for footings and 1:2¼:3 mix for foundation. Foundation wall to extend 2 feet below and 6 inches above ground. Requires 78 sacks cement, 7 yards sand and 10 yards pebbles.

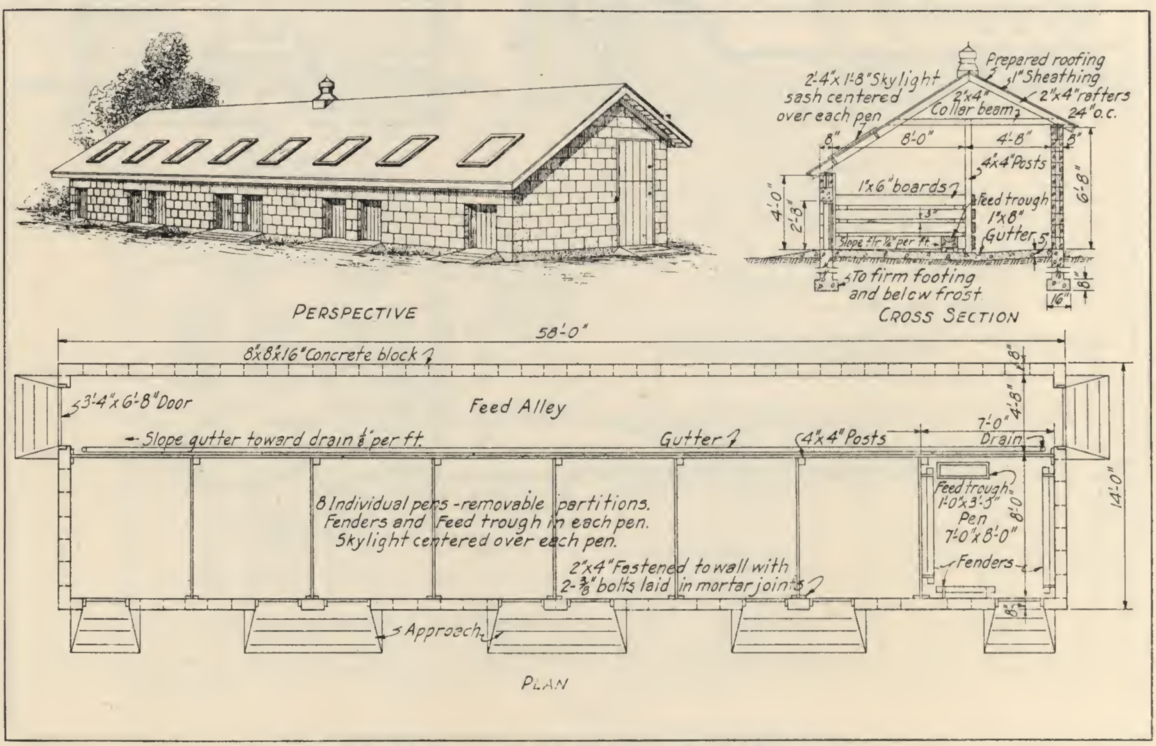
Floor and Approaches: Estimate based on 1:2¼:3 mix. Requires 72 sacks cement, 6 yards sand and 8¾ yards pebbles.

Troughs and Lintels: Estimate based on 1:2¼:3 mix. Requires 7 sacks cement, ¾ yard sand and 1 yard pebbles. Requires 120 lineal feet of ¼-inch round reinforcing rods and 80 lineal feet of ½-inch round reinforcing bars.

Wall: 8 inches thick. Requires 700 concrete block 8x8x16 inches; 32 corner block 8x8x16 inches; and 60 half-block 8x8x8 inches.

If wall is built of concrete building tile instead of block, 1625 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 5 sacks cement, 5 cubic feet lime and 1⅛ yards sand for mortar for block. For tile, 1½ times these amounts.

If wall is built of monolithic concrete (1:2¼:3 mix) instead of block or tile, 107 sacks cement, 9 yards sand and 12 yards pebbles will be needed in addition to that estimated for foundation and floor.



Plans for single row farrowing house. (Drawing B-2172)

An open-air concrete exercise lot is a worthwhile addition to any hog house.

HALF MONITOR HOG HOUSES

A TYPE quite popular in some sections is the half monitor, so called because of the shape of the roof. This type of building should always run east and west, the windows in the monitor permitting sun to strike the pens along the north wall while the windows in the south wall admit sunshine to the pens along that side of the house. Since the sun's rays have different slants at different seasons and latitudes, the builder should always figure out the height at which to place the monitor windows. The following table will be found helpful in determining these heights. This table is based on the assumption that the face of the monitor is 12 feet away from the north wall. If other dimensions are followed, corrections must be made to suit:

In this modern hog house, concrete was used for pen walls. Note the extreme cleanliness.

CORRECT HEIGHT OF HALF MONITOR WINDOWS FOR DIFFERENT SECTIONS AND DIFFERENT FARROWING DATES

(Look up degree of latitude of the locality and use following table to find height at which to place windows in order to get most sunlight on hog house floor.)

Locality	Height to Top of Window (Distance A) (When windows are 12 ft. away from North Wall)		
Latitude Degrees N.	Farrowing Feb. 1 Ft. In.	Farrowing Mar. 1 Ft. In.	Farrowing Apr. 1 Ft. In.
30	11 1	15 6	25 0
32	10 4	14 5	22 11
34	9 8	13 5	21 1
36	9 0	12 7	19 6
38	8 4	11 8	18 1
40	7 9	10 11	16 9
42	.. ..	10 2	15 7
44	.. ..	9 6	14 6
46	.. ..	8 10	13 6
48	.. ..	8 2	12 7

The east and west direction of a half monitor hog house is ideal for location of a sanitary concrete feeding floor and "sun" pens on the sheltered south side of the house for use during early spring months.

MATERIALS REQUIRED

(22 feet by 49 feet 4 inches outside dimensions)
Drawing No. C-615

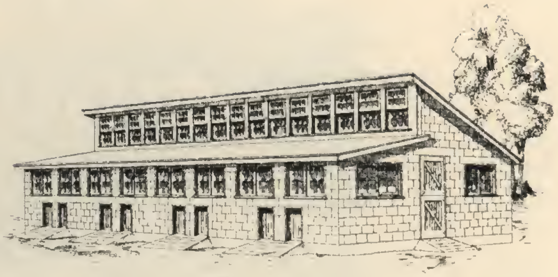
Footings and Foundation: **Estimate based on 1:2¾:4 mix for footings and 1:2¼:3 mix for foundation. Foundation wall to extend 2 feet below and 6 inches above ground. Pier footings 1 foot deep. Requires 81 sacks cement, 7¼ yards sand and 10½ yards pebbles.**

Floor: Estimate based on 1:2¼:3 mix. Requires 98 sacks cement, 8¼ yards sand and 11 yards pebbles.

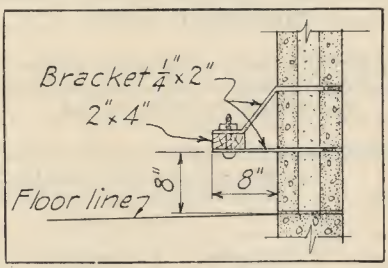
Wall: 8 inches thick. Requires 620 concrete block 8x8x16 inches; 36 corner block 8x8x16 inches; and 133 half-block 8x8x8 inches. Lintels over doors and window openings will require 6½ sacks cement, ½ yard sand and ¾ yard pebbles. Reinforcing steel for lintels consists of 8 pieces of ⅜-inch bars each 6 feet long, 8 pieces of ⅝-inch bars each 6 feet long and 2 pieces of ½-inch bars each 4 feet 6 inches long. (See page 65 for lintel construction.)

If wall is built of concrete building tile instead of block, 1550 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 5 sacks cement, 5 cubic feet lime and 1⅛ yards sand for mortar to lay block. For tile, 1½ times these amounts.

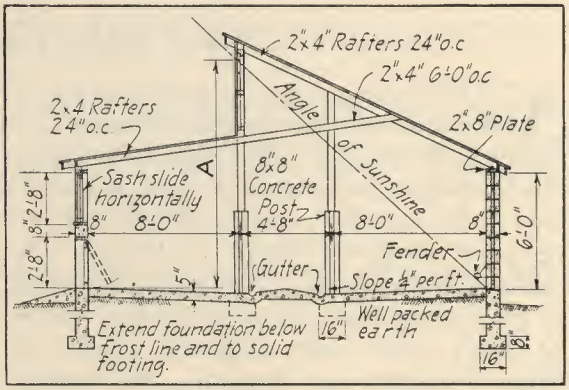
If wall is built of monolithic concrete (1:2¼:3 mix) instead of block or tile, 112 sacks cement, 9½ yards sand and 12½ yards pebbles will be needed in addition to that estimated for foundation and floor.



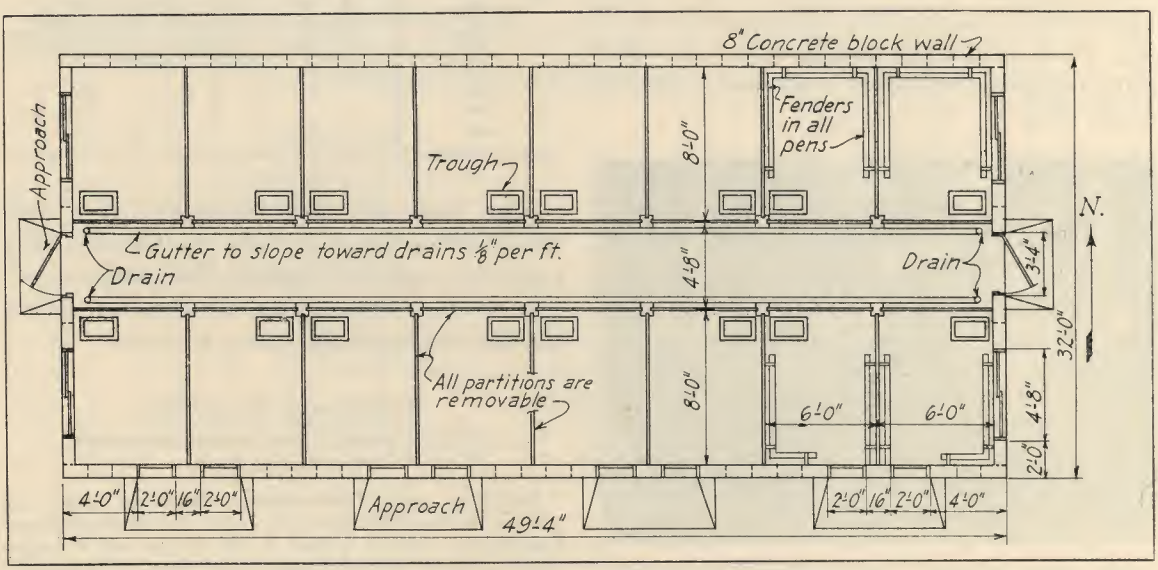
Perspective
Half monitor hog house built of concrete masonry.



Detail of pig fender. (Drawing C-615)



Cross-section of half monitor hog house. (Drawing C-615)



Plan of half monitor hog house. (Drawing C-615)

Insulating Concrete Farm Buildings

PROPER insulation of farm buildings against both heat and cold has come to be recognized as an important factor in livestock health and profit. In colder climates especially, insulation is important in assuring warm, dry, well-ventilated quarters during the winter months. Insulation aids in providing temperature control which is essential for efficient operation of natural draft ventilation systems.

All types of buildings may be adequately insulated to provide the desired degree of temperature control and at the same time secure the advantages of durability and low upkeep cost provided by concrete construction.

Warm, dry, healthful and comfortable in winter is this dairy barn with insulated concrete walls.

In two-story barns, insulation usually is applied to the bottom of the loft floor.

Winter temperatures in buildings with low roofs, such as poultry and hog houses and single-story dairy barns, having concrete masonry walls usually can be satisfactorily controlled by properly insulating the roof. The insulation provided by the air spaces in the concrete masonry walls can be increased by filling the core spaces with cinders or other loose insulating material.

In the more severe climates, either concrete masonry or monolithic concrete walls may be insulated by applying rigid insulation from ½ inch to 1 inch thick to the inside of the walls.

Two methods are commonly used. One is to fur out the insulation with furring strips attached to the concrete wall. The other is to cement insulating board directly to the wall with waterproof bituminous mastic. Insulating board for this purpose is available in units 18 inches by 32 inches, 1 inch thick, and is tongued and grooved. Portland cement plaster is applied to the insulation for a height of three to four feet.

The illustrations on page 64 show several types of concrete wall construction, with different methods of insulation. The space in the monolithic concrete hollow wall may be filled with one of several approved types of loose insulating material or a waterproofed rigid insulation may be placed in the forms and the concrete placed in uniform layers on both sides. The double wall thus formed is tied together with metal ties.

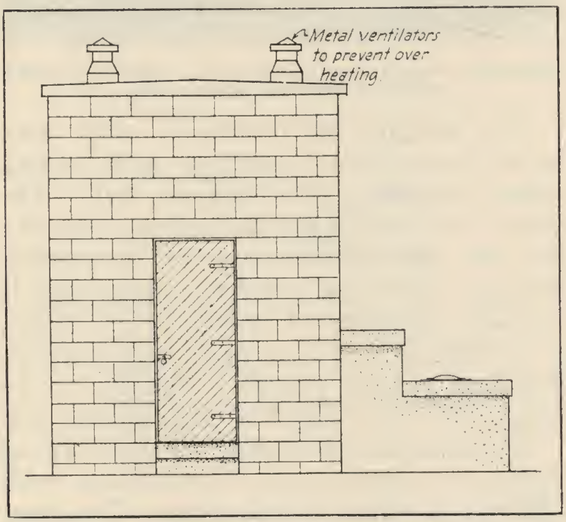
Hollow walls of concrete masonry are also economically insulated. Such a wall may consist of a 4-inch exterior wall, a 1-inch air space, and an 8-inch inner wall, the total wall thickness and thickness of the concrete units depending upon the load imposed by the roof or second story and the size of standard units that are available. The space between the walls may be left open, or filled with cinders or other form of loose insulating material.

Firesafe Smoke Houses

THE smouldering fire in a smoke house offers a constant fire threat unless housed in a firesafe building. Consequently, it is desirable to build the whole structure of firesafe concrete to safeguard the contents as well as the building and eliminate a fire menace to nearby structures.

It is best to build the fire pit outside the smoke house, a connecting flue allowing smoke to enter the room where meats are hung. If the fire is to be built directly on the floor of the smoke house, the meat should be hung at least 6 feet above the fire to prevent overheating.

Small smoke house of concrete masonry stuccoed on the exterior.



Front elevation. (Drawing C-1440)

MATERIALS REQUIRED

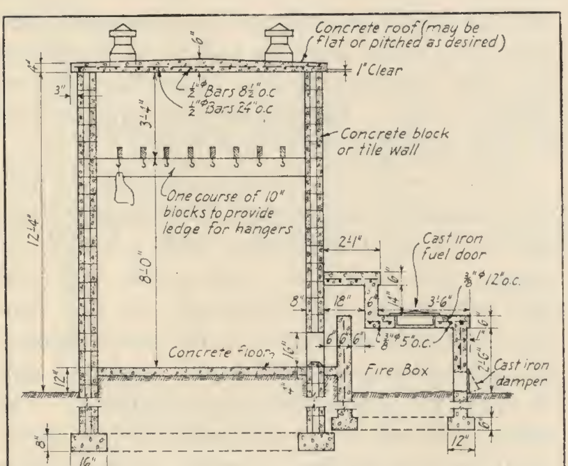
(8 feet by 9 feet 4 inches outside dimensions)
Drawing No. C-1440

Footings: Estimate based on 1:2¾:4 mix. Requires 6¾ sacks cement, ¾ yard sand and 1 yard pebbles.

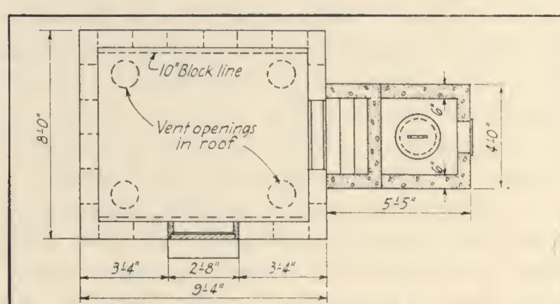
Floor, Roof, Firepot: Estimate based on 1:2¼:3 mix. Firepot wall assumed to extend 2 feet below grade. Requires 23 sacks cement, 2 yards sand and 2¾ yards pebbles.

Wall: 8 inches thick, 2 feet below grade, block used below grade in building proper. Requires 380 concrete block 8x8x16 inches; 76 corner block 8x8x16 inches; and 20 half-block 8x8x8 inches. If concrete building tile are used instead of block, 1000 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 3¼ sacks cement, 3¼ cubic feet lime and ¾ yard sand for block. (Mortar requirements, when tile are used instead of block, are 1½ times those for block.)

If wall is built of monolithic concrete (1:2¼:3 mix) instead of block or tile, 68 sacks cement, 5¾ yards sand and 7½ yards pebbles will be needed in addition to that required for footings, floor, roof and firepot.



Cross-section of smoke house. (Drawing C-1440)



Floor plan of smoke house. (Drawing C-1440)

Grain Bins and Corn Cribs

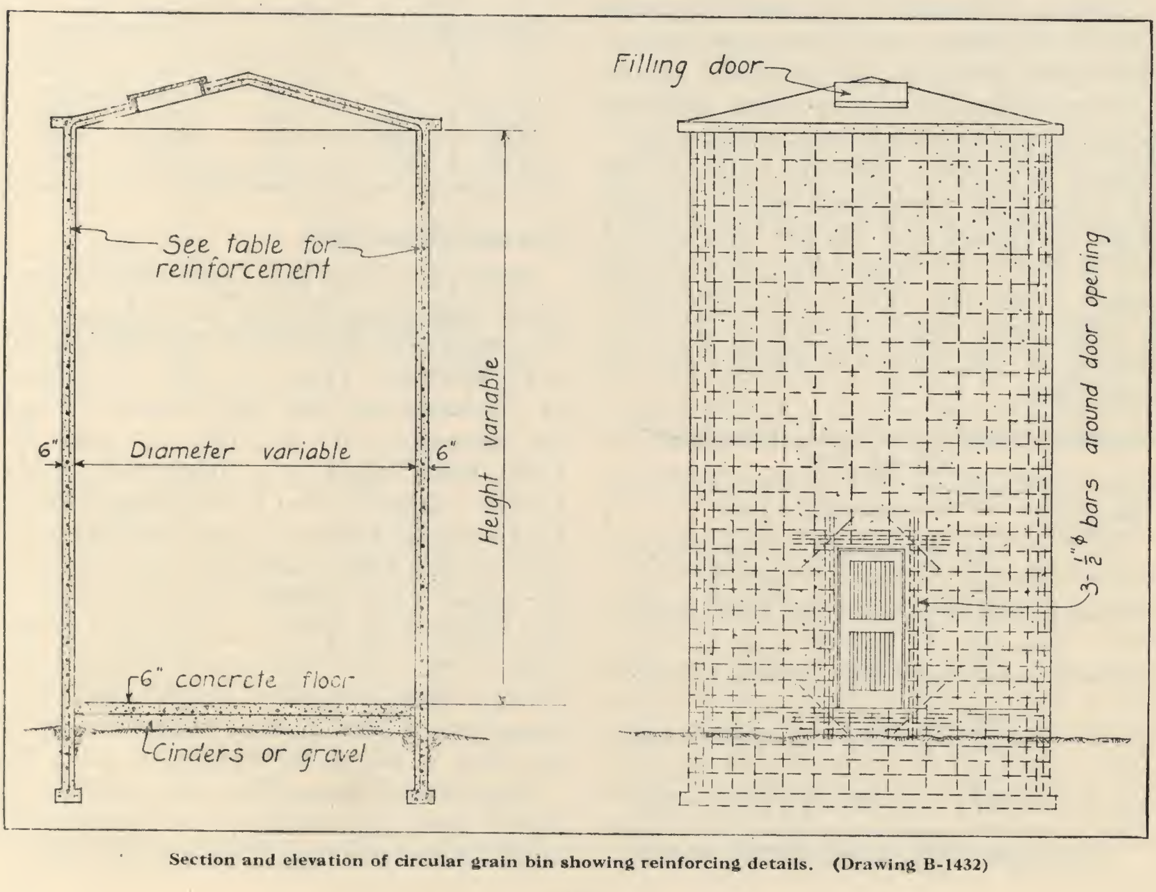
THE proven durability and firesafety of concrete construction make it especially suitable for grain storage structures. Most large modern elevators are now built of concrete, which keeps out rats and vermin and provides dry storage for the grain.

These advantages apply equally well to concrete grain storage for the farm. As each rat eats or destroys at least two dollars' worth of food per year, the value of the protection afforded by ratproof concrete amounts to considerable.

Concrete grain bins help in combating the weevil. This insect lives over from year to year in kernels of corn or grain. It also finds shelter in the cracks in floors or walls, conditions which are highly improbable with concrete bins. Smooth floors and walls of concrete are easily cleaned and disinfected and the larvae thus destroyed.

One of the prime essentials in successful storage of grain is dryness. Recommended mix and instructions for making concrete which will not allow the penetration of water from the outside may be found on pages 51 to 55. Concrete floors should be finished smooth and the joints between walls and floors given a coating of cement wash to insure watertight connections. Additional protection against moisture is obtained by placing the floor on a well-compacted fill of gravel, crushed stone or cinders from 6 to 8 inches deep.

A well-built concrete corn crib or grain storage bin is a permanent improvement that will assure safe storage without loss in quality.



Section and elevation of circular grain bin showing reinforcing details. (Drawing B-1432)

Corn crib with overhead storage for small grains, built of concrete tile.

Concrete stave corn crib, a popular type in all grain growing regions.

Square Grain Bins

Correct thickness of walls and the proper amount of reinforcement for square bins to store small grains are given in the accompanying table. Upper figure gives thickness of wall, lower figure gives size and spacing of bars. For example, a grain bin 10 feet square by 10 feet deep should have walls 5½ inches thick, reinforced with ½-inch round bars 6 inches apart in the lower 5 feet of bin. In the upper 5 feet the ½-inch bars are spaced 8 inches apart. Bars are placed in the outer portion of the wall, 1¼ inches from the outer face.

REINFORCEMENT AND WALL THICKNESS OF SQUARE BINS

Depth in Feet from Top	Dimensions in Feet			
	8 x 8	10 x 10	12 x 12	14 x 14
5 or less	4″ ½″ @ 10″	4″ ½″ @ 8″	4½″ ⅝″ @ 10″	6″ ⅝″ @ 9″
5 to 10	4″ ½″ @ 8″	5½″ ½″ @ 6″	6½″ ⅝″ @ 8″	8″ ⅝″ @ 6″
10 to 15	4½″ ½″ @ 6″	5½″ ½″ @ 6″	7″ ⅝″ @ 6″	9″ ⅝″ @ 5″
15 to 20	4½″ ½″ @ 6″	6″ ½″ @ 6″	7″ ⅝″ @ 6″	9½″ ⅝″ @ 5″

Vertical reinforcement—½-inch round bars spaced 18 inches apart.

CAPACITY OF SQUARE BINS IN BUSHELS

Depth of Bin	Dimensions in Feet			
	8 x 8	10 x 10	12 x 12	14 x 14
5 feet	400	625	900	1225
10 feet	800	1250	1800	2450
15 feet	1200	1875	2700	3675
20 feet	1600	2500	3600	4900

Circular Grain Bins

Walls of circular grain bins of the monolithic type are generally six inches thick. The usual type of construction is illustrated in the drawing on page 31. Size and spacing of reinforcement and capacities of various size bins are given in tables on page 33. From these tables it is found that a bin 12 feet in diameter and 15 feet deep will hold 1364 bushels of grain. It must be reinforced with ⅜-inch bars spaced 24 inches apart in the upper 5 feet of wall, 18 inches apart in the middle 5 feet and 15 inches apart in the lower 5 feet. For vertical reinforcement use ⅜-inch bars 18 inches apart in all bins regardless of size. Special reinforcement at the door is shown in drawing on page 31.

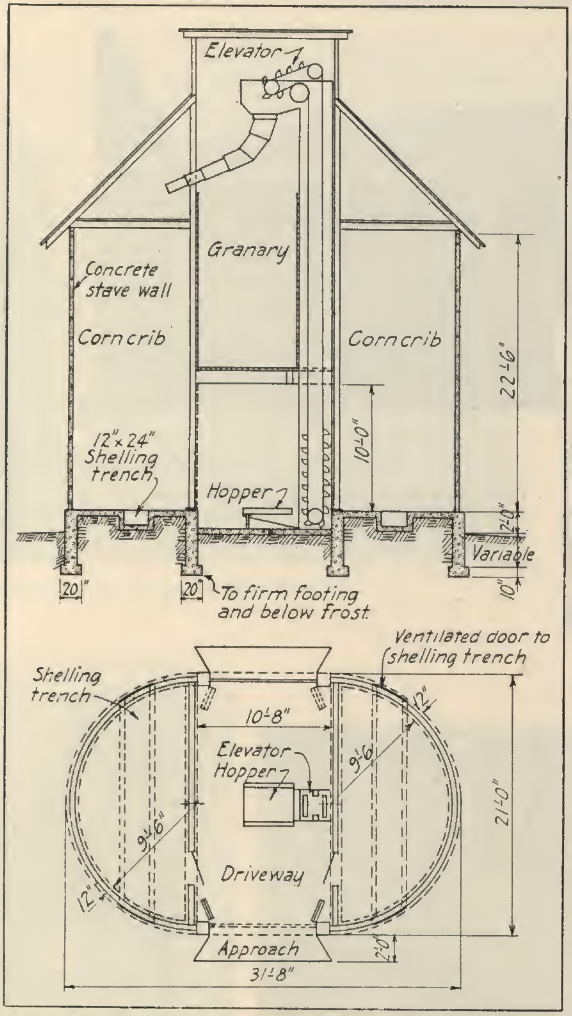
Experienced monolithic silo builders, in nearly every community, are equipped to build circular concrete grain storage bins.

CAPACITY OF CIRCULAR BINS IN BUSHELS

Height in Feet	Diameter in Feet					
	10	12	14	16	18	20
10	631	910	1238	1616	2042	2525
15	946	1364	1855	2420	3060	3785
20	1212	1820	2475	3230	4090	5050
25	1578	2275	3095	4040	5100	6310

REINFORCEMENT FOR CIRCULAR BINS

Depth in Feet from Top	Diameter in Feet					
	10	12	14	16	18	20
0– 5	3/8" @ 24"	3/8" @ 24"	3/8" @ 24"	3/8" @ 24"	3/8" @ 24"	3/8" @ 18"
5–10	3/8" @ 24"	3/8" @ 18"	3/8" @ 15"	3/8" @ 12"	3/8" @ 12"	3/8" @ 12"
10–15	3/8" @ 18"	3/8" @ 15"	3/8" @ 12"	3/8" @ 10"	3/8" @ 8"	3/8" @ 6"
15–20	3/8" @ 15"	3/8" @ 12"	3/8" @ 10"	3/8" @ 8"	3/8" @ 6"	3/8" @ 6"
20–25	3/8" @ 15"	3/8" @ 12"	3/8" @ 8"	3/8" @ 6"	3/8" @ 6"	3/8" @ 5"



Section and plan of combination concrete stave corn crib and granary. (Drawing C-749)

MATERIALS REQUIRED

Circular Grain Bins of Various Diameters

Inside Diameter Feet	For bin 10 feet deep Includes footing and floor			For each additional 5 feet in depth		
	Cement Sacks	Sand Cu. Yd.	Pebbles Cu. Yd.	Cement Sacks	Sand Cu. Yd.	Pebbles Cu. Yd.
10	58	6	8¾	17	1¾	2½
12	69	7	10¼	20	2	3
14	80	8	12	24	2½	3½
16	93	9½	14	27	2¾	4
18	107	11	16	30	3	4½
20	119	12¼	17¾	33	3½	5

Estimated on 1:2¾:4 mix for footings, 1:2¼:3 mix for foundation and wall, and 1:2¼:3 mix for floors. Foundation wall 3 feet below ground and 6 inches above.

Combination Corn Cribs and Granaries

One of the most practical types of grain storage building for the farm is the combination corn crib and granary, commonly constructed of concrete staves as shown in the illustrations and drawing. Tall masonry buildings of this type add to the appearance of the farmstead and furnish facilities for the storage of large quantities of grain with minimum risks from fire or rodents.

Abundant ventilation is provided through the masonry walls by openings in staves. These openings are screened to exclude rats and mice by the use of steel rods or mesh imbedded in the concrete.

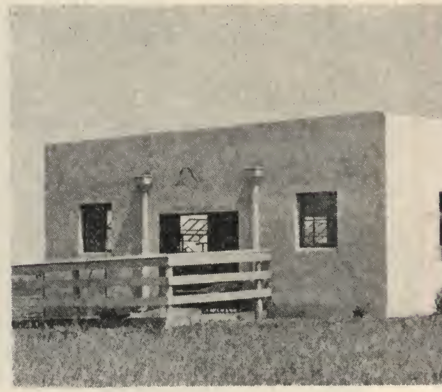
The trench or dragway in the floor enables corn to be dropped directly into the drag or conveyor when shelling, with a minimum of hand shoveling. The thickness of the floor and height of foundation should be sufficient to provide ample room for the sheller drag and to prevent water accumulating and freezing in the dragway during winter.

As small grain exerts a greater lateral pressure than ear corn, additional strength members are provided for the grain bins above by beams and girders designed to resist the pressure of the grain and to tie the structure together. Concrete products manufacturers, specializing in the business, make the staves and blocks and also handle the construction of the building. Names of such companies will be furnished on request.

Concrete . . . First Choice for A

Stucco on concrete tile.

Retaining wall and farm entrance.



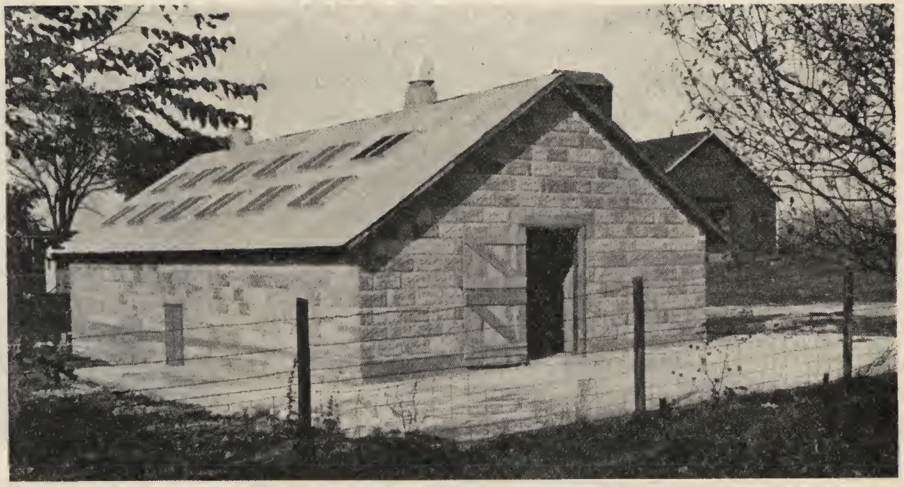
(Above) Concrete masonry open front poultry house in Virginia. (Left) Southern type dairy barn.

Concrete is first choice for all types of permanent home and farmstead improvements.

Concrete masonry finished v
for this Massac

ll Types of Farm Construction

king barn in Texas.



Skylight hog house of concrete masonry on an Illinois farm.

Silos, concrete stave and monolithic concrete.

House of concrete masonry in Michigan.

hite portland cement paint was used
ts Cape Cod cottage.

Monolithic concrete ranch house in California.

A Safe Bull-Pen

THE following statement by E. T. Wallace, Assistant in Dairy Extension at Purdue University, Lafayette, Indiana, illustrates the interest and attention being given to the proper housing for dairy sires:

"The success and achievement of any dairyman is influenced by three factors:

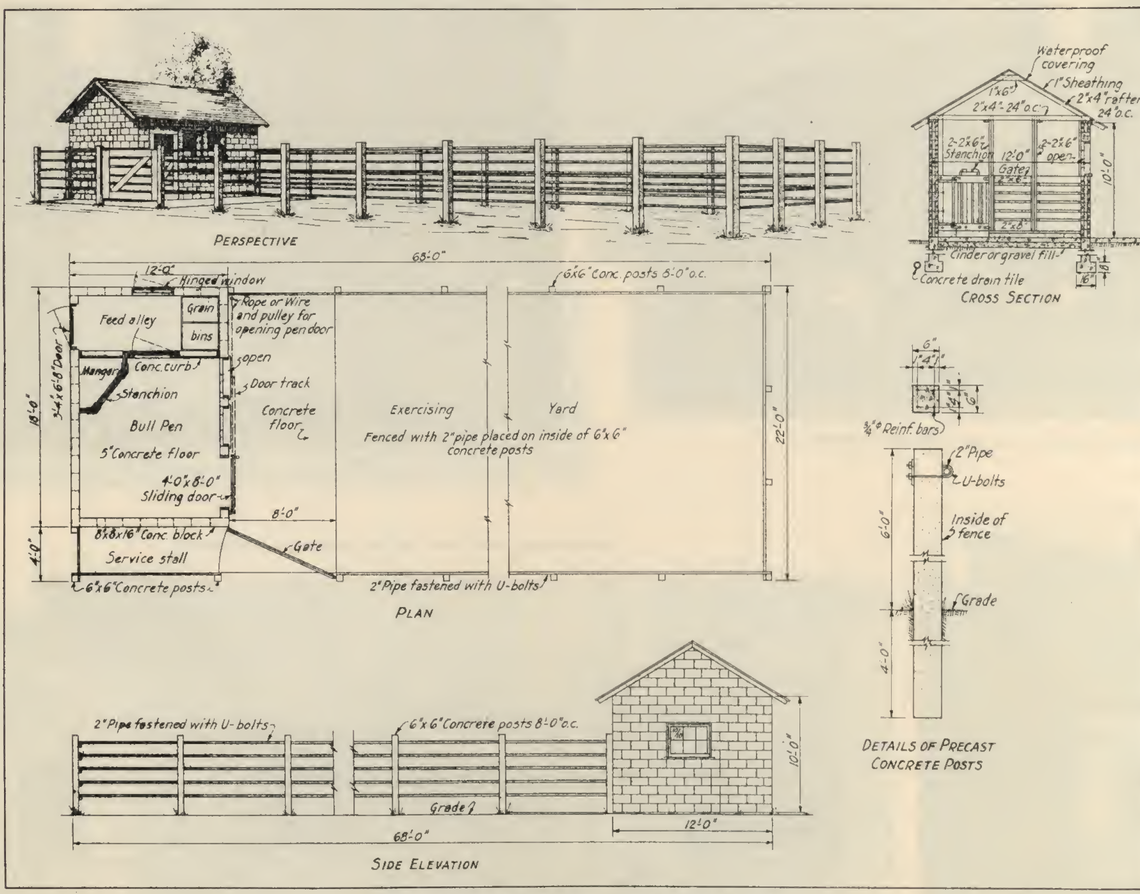
(1) The cows that he owns

(2) His methods of management

(3) The sire used

"A good dairy sire should improve the type and increase the production of each generation. His true value cannot be established until yearly records are available on his daughters. Proving dairy sires through their daughters is one method of providing for 'insured' sires. Using proved sires is the only method of 'insuring' dairy herd improvement.

Solid concrete walls, surmounted by a railing constructed of pipe, form the enclosure for this bull-pen.



Plans for a safe bull-pen. (Drawing C-2173)

"The bull-pen makes both possible. It is the safest and most satisfactory means of properly caring for the dairy sire. Exercise, sunlight and safe confinement are all provided through the bull-pen. The wise dairyman builds permanently, and a permanent, well-constructed bull-pen is rapidly becoming a necessity on every well-equipped dairy farm."

Suggestions for Bull-Pen Construction

The size of the bull-pen depends on the space available, although a minimum area of 1,000 square feet to give ample exercising space is recommended.

The shed and the fence for exercising yard must be strongly constructed, concrete walls and posts being recommended. The fence should be open so that the bull can see what is going on. This tends to keep him quiet and in good temper. The service stall as shown by plans is a further safeguard. The sliding door opening from the shed to the yard is hung on a sloping track so that it will be self-closing. The door is outside the building. Strong guides are placed at the bottom so that it will be impossible for the bull to push the door off the track.

MATERIALS REQUIRED
(12 feet by 18 feet outside dimensions)
Drawing No. C-2173

Footings and Foundation: Estimate based on 1:2¾:4 mix. Foundation wall to extend 2 feet below and 6 inches above ground. Requires 27 sacks cement, 2¾ yards sand and 4 yards pebbles.

Floor in Pen, Service Stall and 8 Feet of Yard: Estimate based on 1:2¼:3 mix. Requires 38 sacks cement, 3¼ yards sand and 4¼ yards pebbles.

Posts and Lintels: Estimate based on 1:2¼:3 mix. Requires 12 sacks cement, 1 yard sand and 1½ yards pebbles. Reinforcing steel for posts, 64 pieces of ¾-inch bars each 9 feet 9 inches long. Reinforcing steel for lintels, 12 pieces of ¾-inch bars each 5 feet long.

Wall: 8 inches thick. Requires 420 concrete block 8x8x16 inches; 52 corner block 8x8x16 inches; and 48 half-block 8x8x8 inches.

If wall is built of concrete building tile instead of block, 1050 units 5x8x12 inches will be needed. Mortar proportions, 1 part cement, 1 part lime and 6 parts sand. Requires 3½ sacks cement, 3½ cubic feet lime and 21 cubic feet sand for block. For tile, 1½ times these amounts.

Permanent Shops and Machine Sheds

ADEQUATE shelter and care prolong the life of farm machines, protecting them against decay. It is usually convenient and economical to include a repair shop under the same roof as the machine shed. Necessary repair work can then be done regardless of weather.

In estimating the size of building needed, it is best to make a list of machines to be sheltered and the space to be occupied by each. Then the floor area can be accurately planned to provide a definite place for each piece of equipment. Crowding should be avoided. Although dimensions of machines vary, the accompanying table compiled by the University of Minnesota should prove helpful in determining space requirements.

An 18-foot wide building will generally accommodate one row of machines—26 feet allows for two rows, placing a long and a short machine opposite each other. Greater width than 26 feet is uneconomical, making necessary larger trusses to support the roof, as well as objectionable center posts.

A concrete repair pit may be built into the repair shop. Such a pit provides excellent facilities for greasing and oiling. It can be covered when not in use.

VARIOUS ITEMS OF FARM EQUIPMENT WITH DIMENSIONS

	Feet
Automobile	7 x 16
Binder	8 x 15
Buggy	7 x 12
Corn binder	7 x 10
Corn cultivator (1 row)	5 x 6
Corn cultivator (2 row)	6 x 10
Corn planter	6 x 6
Disk harrow	5 x 9
Gang plow	6 x 8
Grain drill	6 x 12
Harrow	4 x 6
Hay loader	10 x 12
Manure spreader	7 x 12
Mower	5 x 8
Potato digger	5 x 8
Rake	6 x 12
Side-delivery rake	8 x 12
Silage cutter	7 x 8
Sulky plow	5 x 7
Tedder	6 x 10
Tractor	7 x 14
Wagon	7 x 14

Expensive machinery depreciates rapidly in value and usefulness when standing in the open.

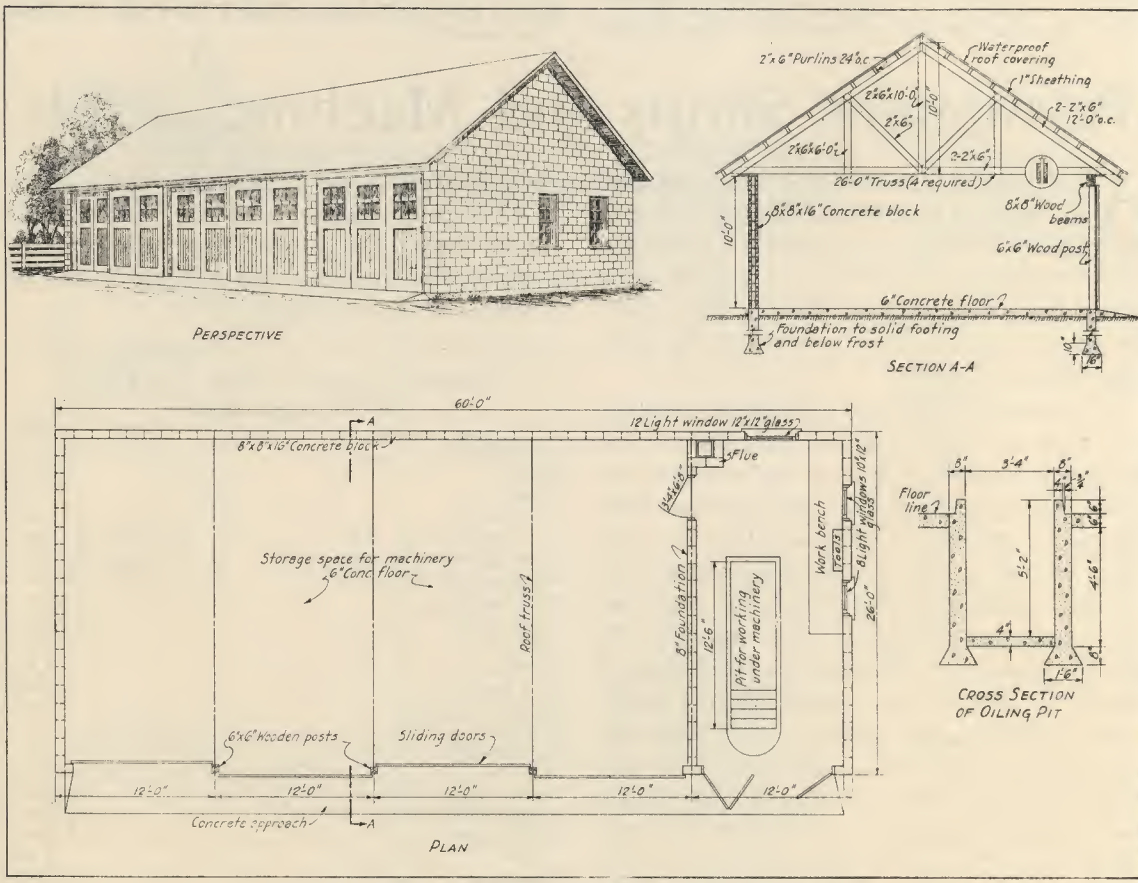
Machinery and tools are kept bright and new-looking when stored in a concrete masonry machine shed like this.

Walls are specified of concrete block or concrete building tile, although monolithic concrete may be used satisfactorily. Neither will require painting.

Doors are best constructed in sections. Two 7-foot doors are most satisfactory.

A tight roof is essential as one leak may ruin an expensive machine. Permanent roof covering of concrete roofing tile or cement asbestos shingles is recommended.

Concrete floors are specified for both repair shop and storage room. They are durable, easily cleaned and permit heavy machinery to be moved about readily.



Plans for a combination shop and machine shed. (Drawing C-2174)

It is desirable to close off the repair shop from the rest of the building, as shown in the drawing, in order to provide work space that can easily be heated in winter. To make heating still easier, it is recommended that a tight ceiling be placed on the bottom of the roof truss over the shop area.

MATERIALS REQUIRED

(26 feet by 60 feet outside dimensions)
Drawing No. C-2174

Footings and Foundation: Estimate based on 1:2¾:4 mix. Foundation wall to extend 3 feet below (including spread footing) and 6 inches above ground. Foundation wall under inner wall assumed 2 feet deep included. Requires 87 sacks cement, 9 yards sand, and 13½ yards pebbles.

Floor and Approaches: Estimate based on 1:2¼:3 mix. Requires 182 sacks cement, 15½ yards sand, and 20 yards pebbles.

Greasing Pit: Estimate based on 1:2¾:4 mix. Requires 26 sacks cement, 2¾ yards sand and 4 yards pebbles.

Wall: Eight inches thick. Requires 1378 concrete block 8x8x16 inches; 60 corner block 8x8x16 inches; and 82 half-block 8x8x8 inches.

If wall is built of concrete tile instead of block, 3130 units 5x8x12 inches will be needed. Mortar, 1 part cement, 1 part lime and 6 parts sand. Requires 10 sacks cement, 10 cubic feet lime and 2¼ yards sand for block. For tile, 1½ times these amounts.

If wall is built of monolithic concrete (1:2¼:3 mix), 202 sacks cement, 17 yards sand and 22 yards pebbles will be required.

Storage Cellars

WITH adequate storage facilities the commercial grower of fruits and vegetables can store or sell according to the trend of the crop market. On farms which do not make a business of market crops, a small storage cellar provides a place for keeping fruits and vegetables for home use.

Storage cellars are generally partly covered with earth to benefit from the insulation it affords both in summer and winter. Only concrete should be considered for storage cellar construction, as the damp earth covering would cause rapid decay of less permanent materials. Concrete is watertight, strong and permanent—it does not decay when exposed to alternate wet and dry soil conditions.

Temperature of Storage

Temperature is the controlling factor in successful operation of natural or air-cooled storages. While there is some difference of opinion as to the best storage temperature for the different fruits and vegetables, most authorities agree that favorable results are secured within the following limits:

Potatoes (table stock), 35 to 40 degrees Fahrenheit.

Potatoes (seed), 38 to 40 degrees Fahrenheit.

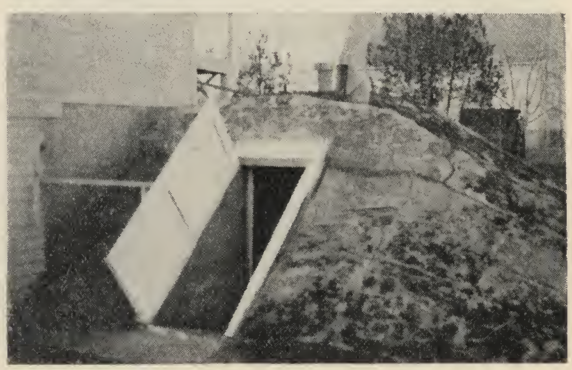
Apples, 30 to 35 degrees Fahrenheit.

Onions, beets, turnips, carrots and similar crops, 35 to 40 degrees Fahrenheit.

Air Circulation

Normal winter earth temperature below frost-line is from 15 to 20 degrees warmer than the average temperature required for successful storage. Consequently, cold air must be brought in to the cellar to maintain

Adequate storage facilities make possible a bountiful supply of fruits and vegetables for year-'round use.



Egg storage cellar built to assure top grade prices when eggs must be kept several days before marketing in hot weather.

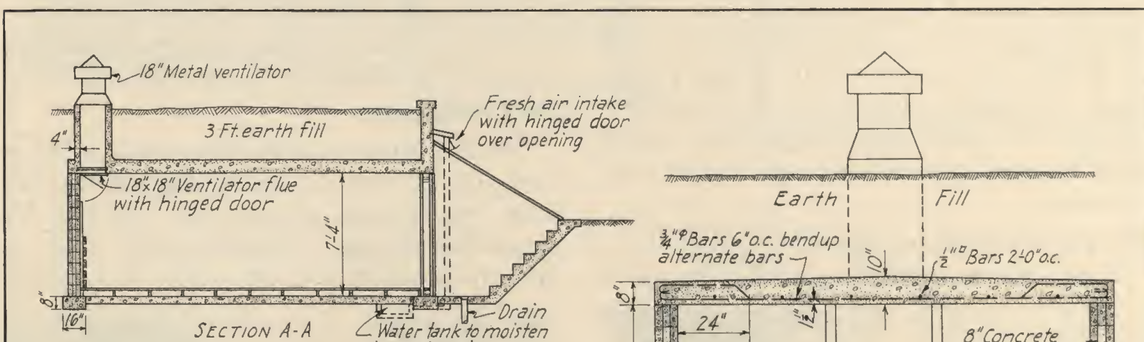
proper temperature for winter storage. Circulation of outside air through the cellar is likewise desirable as it removes excess moisture and gases given off by the stored crops. Accordingly, the storage cellar should be equipped with intakes and outlets of sufficient capacity to secure rapid change and circulation of air. Doors are often provided at each end of the cellar which, when left open, materially aid in air circulation.

Above-freezing temperatures are easily maintained in well-built storage cellars during cold weather. In summer, opening of doors or ventilators at night and closing them in daytime will maintain a sufficiently low temperature to keep eggs, fruit, and vegetables in good condition for periods up to several days. A good cellar is especially important to the owner of a small or medium size poultry flock whose eggs are taken to market only once or twice a week. Eggs can be stored in such a cellar for several days without loss of grade. Wet burlap sacks may be placed in the cellar to aid in lowering the temperature by evaporation of the moisture in the sack.

SMALL FLAT ROOF STORAGE CELLAR

THE drawings below show construction details of a small cellar suitable for storage of fruits and vegetables for home consumption. Either concrete block or monolithic concrete is suitable for the wall construction.

Walls are built first, and, in monolithic construction, are allowed to harden several days before concrete for the roof slab is placed. The roof is reinforced with ¾-inch bars running from wall to wall, spaced 6 inches apart—1½ inches from the bottom of the concrete slab. Ends of bars are hooked to provide good anchorage. Alternate bars are bent up at a point 24 inches from the inside of the cellar wall as shown in the drawing. Additional steel consisting of ½-inch square bars running at right angles



Plans for a small flat roof storage cellar. (Drawing B-331)

to the ¾-inch bars is spaced at 24-inch intervals and laid directly on top of the main reinforcement members. Steel reinforcing members may be purchased cut to proper lengths and bent ready for placing; or they may be bought in stock lengths and cut and bent on the job. Most companies supply these materials bent to proper shape and provide drawings which contain placing instructions.

The parapet walls may be built of concrete block or of monolithic concrete. An 18x18-inch wood frame, 10 inches high, placed in the center of the roof slab at the rear of the cellar, provides an opening for the ventilator flue. The 4-inch concrete floor for the passageway is placed after the rest of the cellar has been built.

MATERIALS REQUIRED

(12 feet by 20 feet inside dimensions)
Drawing No. B-331

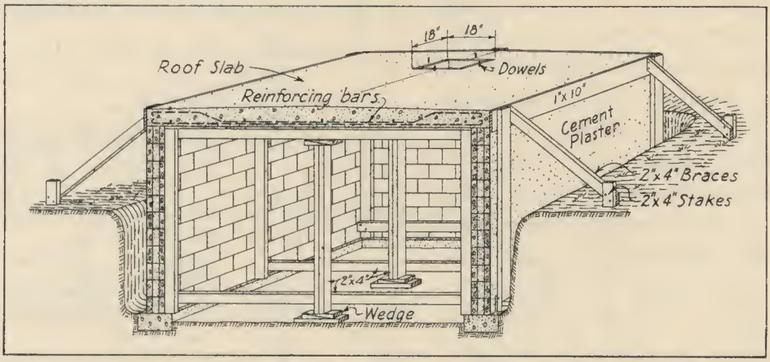
Footings: Estimate based on 1:2¾:4 mix. Requires 11 sacks cement, 1¼ yards sand, and 1¾ yards pebbles.

Wall: 8 inches thick. Requires 522 concrete block 8x8x16 inches and 12 half-block 8x8x8 inches. Coating of cement plaster outside wall (1:3 mix, ½ inch thick) requires 7 sacks cement and ¾ yard sand.

If wall is built of concrete building tile instead of block, 1120 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 3½ sacks cement, 3½ cubic feet lime and 21 cubic feet sand for block. For tile, 1½ times these amounts.

If wall is built of monolithic concrete instead of block or tile (1:2¼:3 mix), 65 sacks cement, 6¼ yards sand and 9¾ yards pebbles will be needed in addition to that estimated for the foundation and floor.

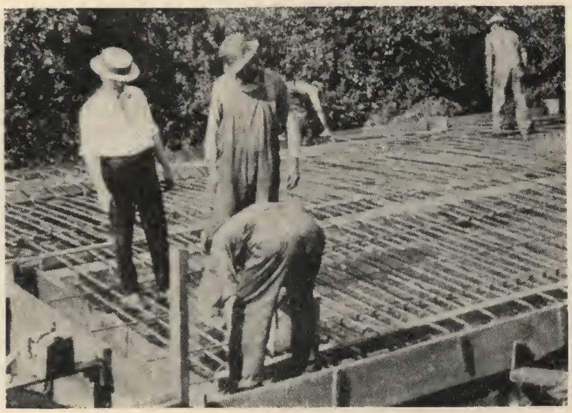
Floor, Roof and Entrance: Estimate based on 1:2¼:3 mix. Requires 71 sacks cement, 6 yards sand and 8 yards pebbles.



Forms for construction of roof slab for a small storage cellar. (Drawing B-2176)

STORAGE CELLAR OF LARGE CAPACITY

THE cellar shown on page 42, being designed in 10-foot sections, is adaptable to the requirements of practically any large fruit or vegetable producer. A cellar 68 feet 8 inches long as shown will provide storage for 5,000 bushels. The capacity is



Reinforcing steel in position, ready to place concrete for large storage cellar roof.

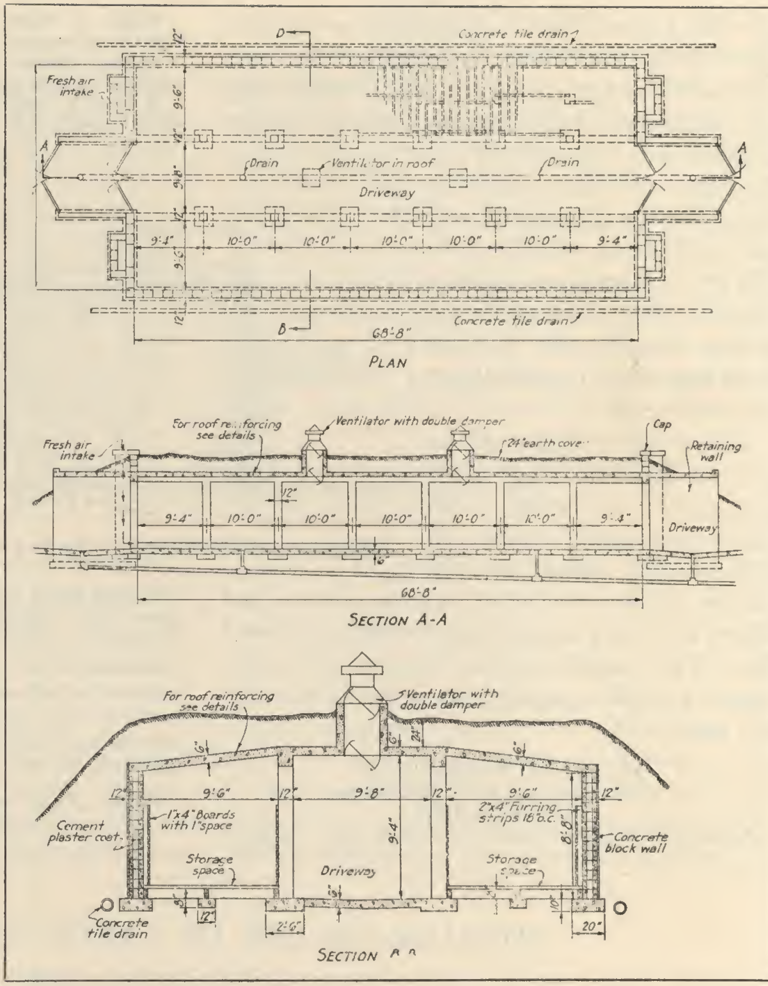
Nearly completed storage cellar with slightly arched concrete slab roof.

considerably greater if part or all of the driveway space is used for storage.

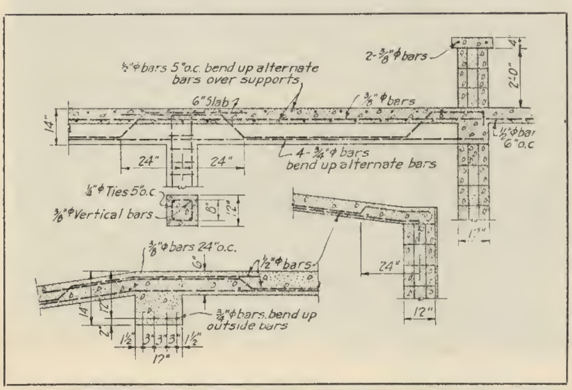
Earth floors are considered best for the storage compartments as the moisture from the ground helps to maintain proper humidity in the cellar. A false floor and wall, built as shown in section B-B, hold the stored crops away from the wall and floor and thus allow space for air movement. Care should be taken to provide for adequate drainage if it is not possible to locate the storage cellar on ground that drains naturally.

The central aisle driveway is floored with concrete. This provides a good firm passageway for moving fruit and vegetables in and out in all seasons. For floor construction see pages 66 and 67.

Concrete block, building tile or monolithic construction are equally suitable. The columns, beams and roof slabs are of structural concrete reinforced with steel. See drawing below.



Plans for storage cellar of large capacity. (Drawing C-1834)



Details of storage cellar roof. (Drawing C-1834)

MATERIALS REQUIRED

(32 feet by 70 feet outside dimensions)

Drawing No. C-1834

Footings Under Walls, Columns and Floor Joists: Estimates based on 1:2¾:4 mix. Requires 82 sacks cement, 8½ yards sand and 12 yards pebbles.

Wall and Retaining Curb: 12 inches thick. Requires 2127 block 8x12x16 inches and 34 half-block 8x12x8 inches. Cement plaster on outside of wall (½ inch thick, 1:3 mix) requires 27 sacks cement and 3 yards sand.

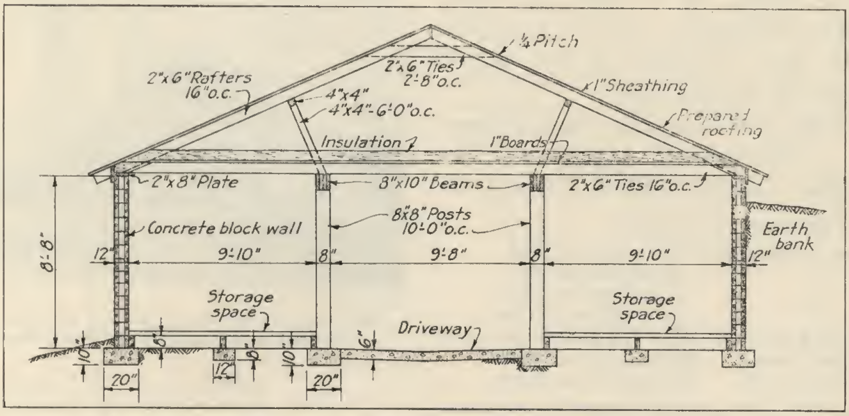
If wall is built of concrete building tile instead of block, 6860 units 5x8x12 inches will be needed. Mortar for laying block or tile, 1 part cement, 1 part lime and 6 parts sand. Requires 14½ sacks cement, 14½ cubic feet lime and 3¼ yards sand for block. For tile, 1½ times these amounts.

If wall (including parapet wall on roof) is built of monolithic concrete instead of block or tile (1:2¼:3 mix), 440 sacks cement, 37 yards sand and 49 yards pebbles

will be needed in addition to that estimated for foundation and floor.

Roof Slabs and Beams, Columns, Caps, Concrete Joists for False Floor, Driveway, Entrance Walls and Roof: Driveway assumed 5 feet in front of each door (1:2¼:3 mix). Requires 530 sacks cement, 45 yards sand and 58½ yards pebbles. Requires 800 feet of ¼-inch rods, 1800 feet of ⅜-inch bars, 6800 feet of ½-inch round bars and 700 feet of ¾-inch bars.

ABOVE-GROUND STORAGE BUILDING



Cross-section of above-ground storage building. (Drawing C-1834)

The above-ground type of storage building for fruits and vegetables is less extensively used. It is customary to insulate the walls and ceiling of these houses to maintain uniform temperatures. They are commonly equipped with stoves which can be used during extremely cold spells.

An above-ground storage building may be built from the same plans as the cellar type. However, the foundation is built deep enough to extend below frost-line and the entire structure, including doors and windows, tightly constructed to prevent possible leakage of air. To provide additional insulation, a pitched roof, shown in the accompanying drawing, is sometimes used. This construction allows for a layer of insulation material in the ceiling. As an additional precaution against heat transfer fur out the walls with metal lath and plaster.

Potato storage cellar of monolithic concrete built partly above and partly below ground on a sloping hillside.

An icehouse of concrete masonry construction provides a year-'round supply of ice at economical cost.

Concrete Water Supply Tank

THE consumption of water on the farm is enormous, running into hundreds of gallons per day. No more practical improvement could be made, nor is there any that will save more drudgery, than a concrete water supply tank which will put water under pressure for instant use.

Storage tanks are usually made large enough for a three-days' supply. The following table should prove helpful in estimating water requirements:

For each member of the family	25 gallons per day
For each horse	10 gallons per day
For each cow*	12 gallons per day
For each sheep	1½ gallons per day
Continuous drinking fountain	50 to 100 gallons per hour
Use of ½-inch hose nozzle	200 gallons per hour
Use of ¾-inch hose nozzle	300 gallons per hour

*Cows giving milk drink about four times as much water as dry cows. High-producing cows will drink from 20 to 30 gallons of water per day. This should be taken into consideration if a large dairy is to be served by the water system.

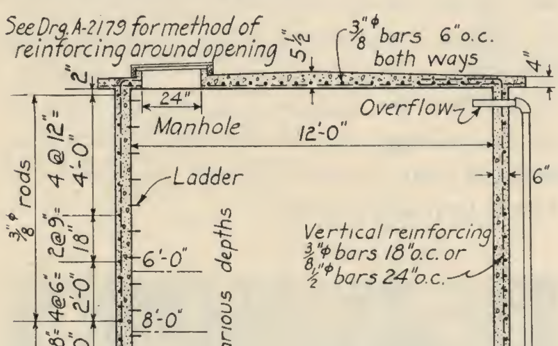
Capacities of cylindrical water tanks 12 feet in diameter and varying in depth from 6 to 16 feet are as follows:

A concrete tank on top of the silo provides the farm with a supply of water under pressure where needed.

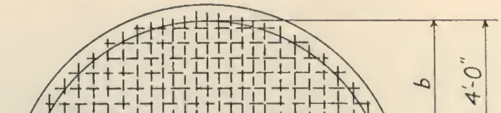
6 feet deep	5,075 gallons
8 feet deep	6,770 gallons
10 feet deep	8,460 gallons
12 feet deep	10,150 gallons
14 feet deep	11,845 gallons
16 feet deep	13,540 gallons

The water supply tank shown in the drawing has a capacity of 13,540 gallons and may be constructed on top of a concrete silo of the same or larger diameter. A water tank located on top of the silo will usually develop pressure sufficient to force water to every building. This also provides fire protection.

The drawings and table show the proper amount of reinforcement for tanks 12 feet in



Cross-section of water supply tank. (Drawing B-645)
(See Drawing A-2179, page 12, for method of reinforcing around opening.)



Plan of reinforcing for floor slab of water supply tank. (Drawing B-645)

diameter and for depths up to 16 feet. Assume a tank is required 12 feet in diameter and 12 feet deep: The lower 2 feet 6 inches should be reinforced with ½-inch round bars spaced at 6-inch intervals; the next 2 feet above with ½-inch bars 8 inches apart; the next 2 feet with ⅜-inch bars 6 inches apart; the next 18 inches with ⅜-inch bars 9 inches apart; and the top 4 feet with ⅜-inch bars 12 inches apart. The floor slab thickness and the amount of reinforcement vary according to the depth of the tank. The floor of a 12-foot deep tank is 9 inches thick. Reinforcing steel in the center third of the floor is spaced 5½ inches apart and that in each of the outer thirds is spaced 8 inches apart. Vertical reinforcement for the walls consists of ⅜-inch bars at 18-inch intervals for depths up to 16 feet. Reinforcing steel is located in the outer portion of the wall and in the lower portion of the floor slab, with not less than 1 inch of concrete between the steel and the wall surface.

For dense, watertight concrete necessary for a leakproof water tank, the mixture must contain not more than 6 gallons water per sack of cement. (See instructions on page 52.) For the trial batch, proportions of 1:2¼:3 are suggested. Proper curing is essential. (See instructions on page 54.)

FLOOR THICKNESS AND REINFORCEMENT FOR TANK FLOORS
(Diameter of Tank—12 feet)

Depth of Tank	Thickness of floor	Spacing in "a" See floor plan	Spacing in "b" See floor plan
6′-0″	7″	7½″	10″
8′-0″	7½″	6½″	9″
10′-0″	8½″	6″	9″
12′-0″	9″	5½″	8″
14′-0″	9½″	5″	7″
16′-0″	10″	4½″	6″

Concrete Manure Pits

PILED in the yard, rains wash soluble fertilizing elements such as potash and phosphorus out of manure—exposure causes fermentation and loss of the valuable nitrogen.

Watertight concrete floors and walls of the concrete manure pit shown retain all the liquids and make it possible to pile the manure deeply, thus retaining the soluble elements and reducing losses. A roof over the pit prevents too much rain water from collecting in the manure. A driveway at one end of the pit provides space where the manure spreader may stand under cover while being loaded direct from the litter carrier or where it can be housed when not in use. Concrete approaches provide easy entrance and exit.

The value of manure saved by a concrete pit will generally pay the cost of the pit in a year's time. Dimensions may be varied to meet requirements, capacity of various sized pits being given by the accompanying table.

Space for storage of mineral fertilizer such as rock phosphate may be set aside in the

A concrete pit for storing manure adds to the appearance of the farm.

DIMENSIONS OF MANURE PITS FOR DAIRY HERDS OF VARIOUS SIZES

(Exclusive of Driveway)

No. of Cows	Length	Width	Average Depth
10	16 ft.	16 ft.	4 ft.
18	24 ft.	18 ft.	4 ft.
20	26 ft.	18 ft.	4 ft.
30	30 ft.	24 ft.	4 ft.
40	40 ft.	24 ft.	4 ft.

manure pit, where it is handy for mixing with the manure—a practice quite generally advocated by soils specialists. Generally, a concrete wall is built to separate the manure pit from this space.

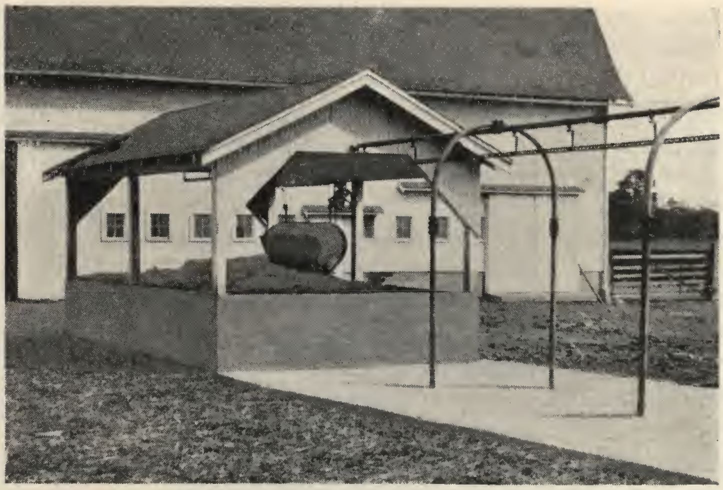
MATERIALS REQUIRED

(18 feet by 37 feet outside dimensions)
Drawing No. B-2175

Foundation: Estimate based on 1:2¾:4 mix. Foundation wall to extend 2 feet below ground. Requires 26 sacks cement, 2¾ yards sand and 4 yards pebbles.

Floor and Approaches: Estimate based on 1:2¼:3 mix. Requires 62 sacks cement, 5¼ yards sand and 7 yards pebbles.

Wall: 8 inches thick, 1:2¼:3 mix. Requires 43 sacks cement, 3¾ yards sand and 5 yards pebbles.

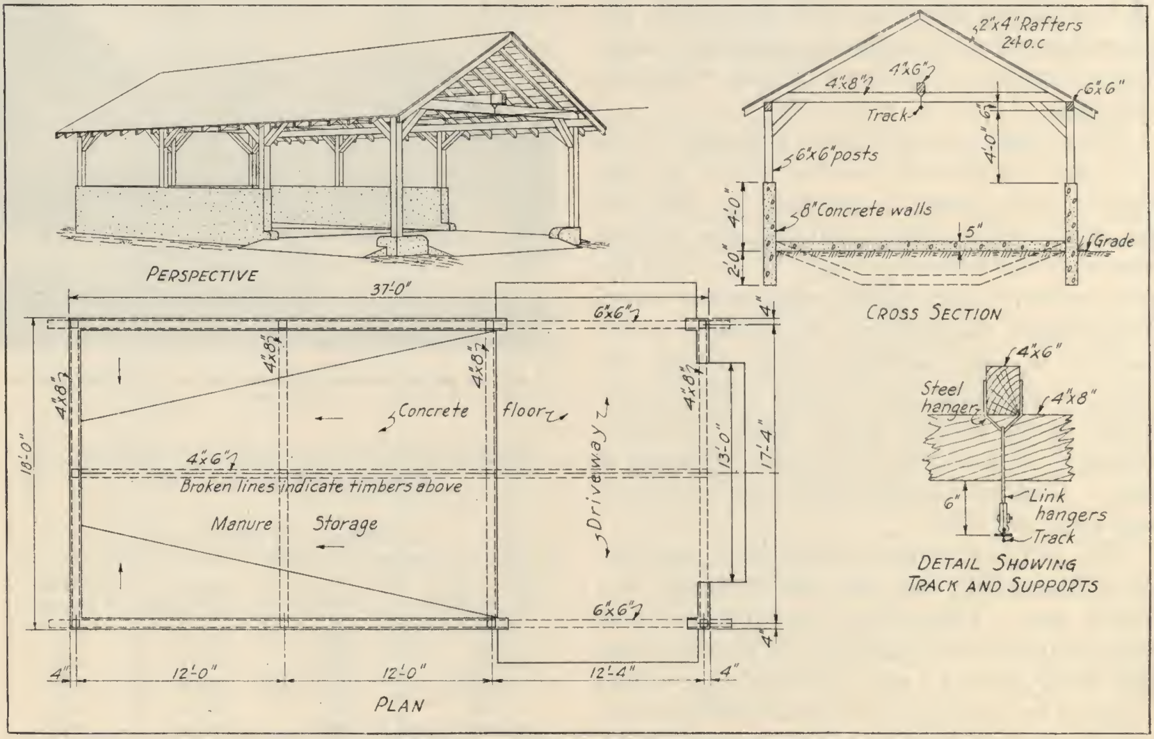


The modern way of handling manure, with a covered concrete pit, prevents loss of valuable fertilizing elements.

Figure Out the Value of the Manure Produced by Your Livestock

	Tons in One Year	Value per Ton	Value for One Year
Horse	5.2	$6.09	$31.67
Dairy Cow	8.5	4.56	38.76
Other Cattle	4.0	5.47	21.88
Sheep	0.4	9.66	3.86
Hog	0.6	6.19	3.71

These figures were taken from Pennsylvania Experiment Station Circular No. 67. Results from several other experiment stations accord with the above figures and substantiate the fact that mixed manure is worth at least $5.00 per ton.



Plans for a concrete manure pit. (Drawing B-2175)

Firesafe Garages

Both the automobile and farm truck are securely housed in this concrete masonry garage.

GARAGES built of concrete have many advantages—firesafety, long life, low upkeep. Excellent facilities for housing the farm automobiles are provided by the two-car garage shown by accompanying plans.

The economy of building this garage is readily appreciated when one considers that twice the space is obtained with the addition of only 25 per cent more wall materials.

For a single-car garage, an inside width of 12 feet has been found satisfactory, while for a two-car garage, 20 to 22 feet of width is necessary. Lengths of less than 20 feet are seldom advisable; for larger cars 22 feet is better. These dimensions allow working space around the car and provide room for small work bench, closet and shelves for car accessories at one end.

If a car and truck are to be stored in a two-car garage, the length of the building should be determined by the length of the truck.

Garages built of concrete are easily heated in winter, especially desirable when used as a combination garage and workshop.

MATERIALS REQUIRED

(20 feet by 22 feet inside dimensions)
Drawing No. C-2349

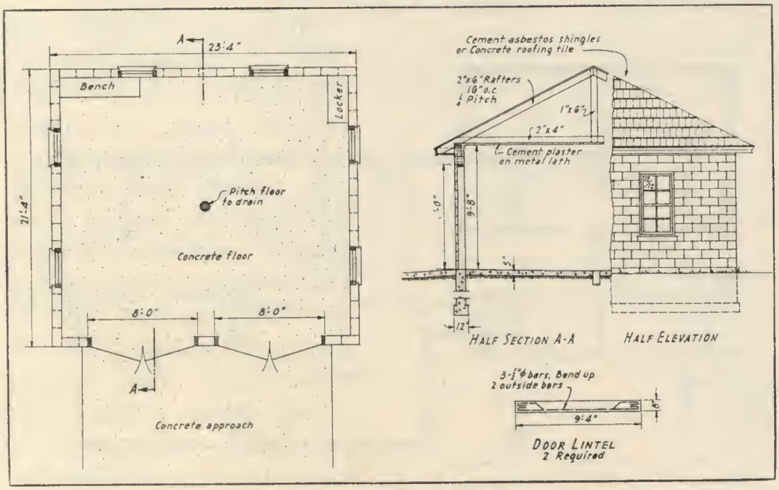
Footings and Foundation: Estimate based on 1:2¾:4 mix for footings and foundation. Foundation wall to extend 2 feet below and 6 inches above ground. Requires 39 sacks cement, 4 yards sand and 6 yards pebbles.

Floor and Approach: Estimate based on 1:2¼:3 mix. Assumed that approach extends 5 feet in front of the buildings. Requires 48 sacks cement, 4 yards sand and 5¼ yards pebbles.

Wall: Eight inches thick. Requires 540 concrete block 8x8x16 inches; 56 corner block 8x8x16 inches; and 84 half-block 8x8x8 inches. Lintels and sills for doors and windows (1:2¼:3 mix) will require 7 sacks cement, ⅝ yard sand and ¾ yard pebbles. Reinforcing steel for door lintels, 4 straight bars ½ inch in diameter by 10 feet long and 2 bent bars ½ inch in diameter and 10 feet 6 inches long. Steel for window lintels, 12 straight bars ½ inch in diameter and 4 feet long.

If wall is built of concrete building tile instead of block, 1350 units 5x8x12 inches will be needed. Mortar, 1 part cement, 1 part lime and 6 parts sand. Requires 4¼ sacks cement, 4¼ cubic feet lime and 1 yard sand. For tile, 1½ times these amounts.

If wall is built of monolithic concrete instead of block or tile (1:2¼:3 mix), 87 sacks cement, 7½ yards sand, and 9¾ yards pebbles will be required.



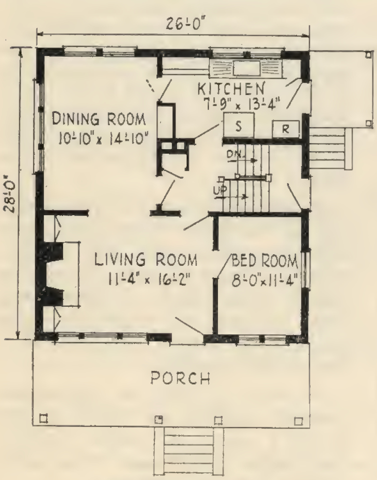
Plan, section and elevation for a two-car garage. (Drawing C-2349)

The Middlebury

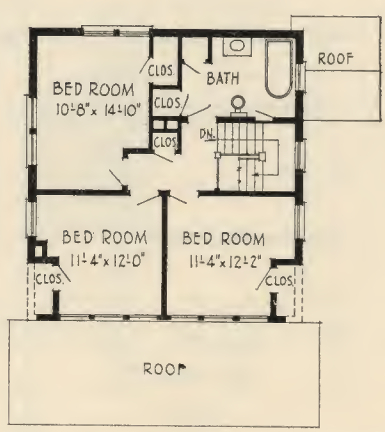
Farm Residence

THE farm house is more than just a place to sleep. In busy seasons it must handle two or three times the normal number of people. It must have a kitchen and domestic equipment that can operate at times like a hotel. It must provide everything from an office to a storage room for food and domestic equipment. It perhaps has more reasons to be fire-resisting than any other building, for in most instances every farm must furnish its own fire department. It must be sanitary, require few repairs and, above all, be comfortable to live in.

The accompanying illustrations show two of several types of successful farm houses and it is easy to see that their designs provide comfortable homes and at the same time are arranged to meet many requirements.



First floor plan.



Second floor plan.

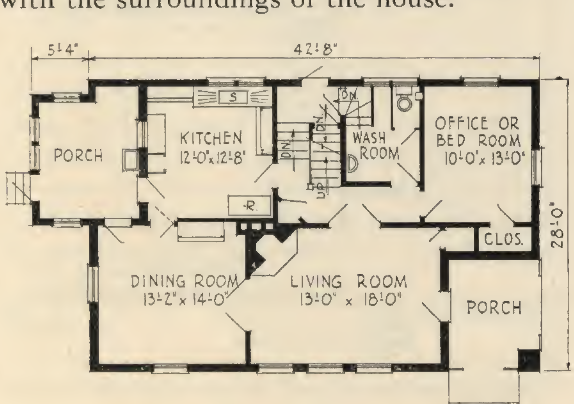
Built of reinforced concrete or concrete masonry, finished with portland cement paint or covered with portland cement stucco, and roofed with fire-resistive concrete roofing tile or cement asbestos shingles, the home is protected against fire—maintenance and repair expenses are practically eliminated. This staunch construction makes them unusually storm-safe, an important consideration in many sections.

The Wakefield

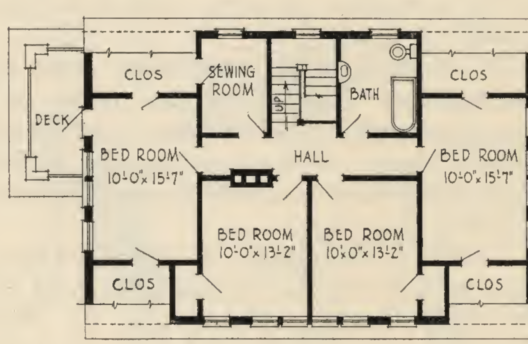
Portland Cement Stucco

Portland cement stucco makes an attractive finish for the farm residence. This stucco has all the qualities inherent in concrete—durability, long-life, firesafety and low maintenance. It is waterproof, it will not rot and it actually grows stronger with age. Many beautiful stucco treatments are possible. Color may be chosen to harmonize with the surroundings of the house.

Many farm houses are being made new and attractive for countless years by "overcoating" them with portland cement stucco. Old farm houses, after undergoing this treatment, take on a substantial and attractive appearance. There is little or no maintenance thereafter. The new "overcoat" becomes firm, rigid concrete, permanent and beautiful, and safeguards the house against weathering action and decay for years to come.



First floor plan.



Second floor plan.

Giving the old farm house an "overcoat" of stucco is really simple and the cost is moderate. Approved methods of application will produce a good job.

Several popular stucco finishes are illustrated in our booklet, "Plasterer's Manual." This booklet also contains suggested specifications for application of the stucco coatings to insure a good job. A free copy of this booklet will be gladly sent upon request.

Floors that Won't Burn

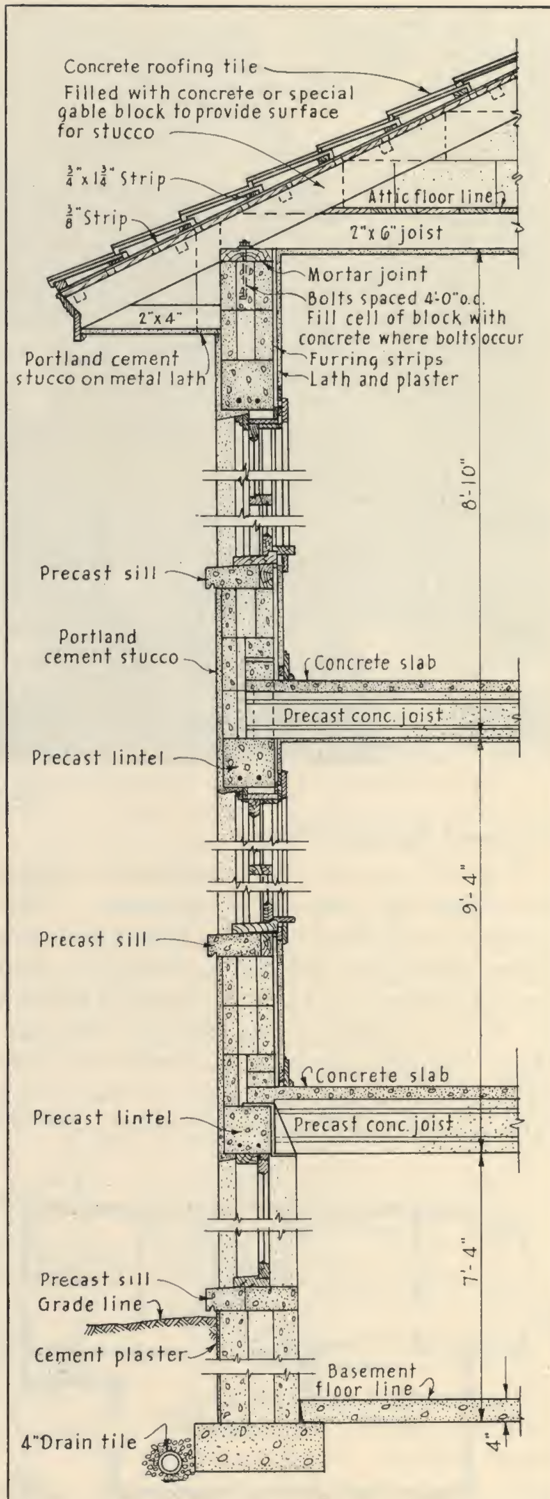
Concrete floors are rightly called the key to firesafe homes. The majority of fires start in the basements of dwellings. A concrete first floor will prevent a basement fire from spreading to the upper part of the house. If the house has no basement, concrete floors will protect against danger from overheated stoves and stove pipes and other common causes of farm house fires.

The illustration on this page shows concrete floors built with precast concrete joists. Development of this method of construction brings the cost of concrete floors within reach of the purse of every home builder, and offers the same degree of fire protection now standard in hotels, apartments, expensive houses and similar buildings. The illustration on page 11 shows concrete joists in place for the first floor of a new home.

Any type of floor surface may be used with concrete floors—wood, linoleum, rubber tile or any other standard floor finish. Or, if desired, the concrete may be marked off in attractive patterns, waxed and polished.

In addition to fire protection, other advantages are secured by the owner of a house built with concrete floors. A concrete floor is rigid. It does not sag nor shrink, thus eliminating common causes of plaster cracking.

Complete information about firesafe home construction may be obtained free from the Portland Cement Association, 33 West Grand Avenue, Chicago. Ask for the booklet, "Here's How It's Built."



Section of a concrete masonry house with concrete floors.

Fundamentals of Good Concrete

THE basic material of concrete is portland cement—a staple product obtainable from practically all dealers in building materials. For convenience in handling or measuring, each sack contains 1 cubic foot (94 pounds) of cement.

Portland cement is a thoroughly dependable product. All the standard brands produced by members of the Portland Cement Association are tested repeatedly and will produce good concrete when properly combined with the other materials necessary for a concrete mixture.

How Cement Is Used to Make Concrete

Portland cement mixed with water forms a paste. When sand and pebbles are so mixed with this paste that every particle is coated, plastic concrete is obtained. This workable mass of cement, water, sand and pebbles, when placed into forms and allowed to stand, becomes hard, similar to stone, due to a process known as the hydration or crystallization of the cement. When properly cured, concrete continues to harden for a long time after it has acquired sufficient strength for the work it has to do. This continued increase in strength is a characteristic of concrete, which is found in no other material.

Amount of Water Controls Strength, Durability

Strength, watertightness and durability of concrete are controlled by the amount of water used per sack of cement. Too much mixing water thins or dilutes the cement paste and weakens its cementing qualities. It is therefore important that the correct amount of water be used to obtain concrete of the required strength and density according to the class of work it is intended for.

Determining Proportions of Cement and Water

Table I gives recommended quantities of water to use per sack of cement for the different classes of farm construction. In mixing half-sack batches, use just half the amount of water indicated. The table also suggests proportions of cement, sand and pebbles for the first batch and gives maximum size of pebbles allowable. Note that with damp sand and pebbles, more water is used than when the materials are in a wet or very wet condition. This is true since the moisture present in wet aggregates is free to act on the cement.

The use of this table can best be explained by an example. Suppose it is desired to determine proper proportions for building a watertight floor. The recommended mix for this class of work is one containing a total of 6 gallons of water per sack of cement. One cubic foot of wet sand contains approximately ½ gallon of water. Consequently, when the aggregates (sand and pebbles) are in a wet condition, only 5 gallons need be added as the water contained in 2 cubic feet of the sand used per sack of cement in this mix (1:2¼:3) totals about 1 gallon. When aggregates are very wet they contain even greater quantities of water and only 4¼

Tools commonly used in farm concrete work.

TABLE I

RECOMMENDED PROPORTIONS OF WATER TO CEMENT AND SUGGESTED TRIAL MIXES

Intended primarily for use on small jobs

Kind of Work	Add U. S. Gal. of Water to Each One-Sack Batch if Sand Is			Suggested Mixture for Trial Batch			Maximum Aggregate Size
	Very Wet	Wet	Damp	Portland Cement	Sand	Pebbles	
5-Gallon Paste for Concrete Subjected to Severe Wear, Weather, or Weak Acid and Alkali Solutions							
		Average Sand		Sacks	Cu.ft.	Cu.ft.	
Colored or plain topping for heavy wearing surfaces; all two-course work such as pavements, walks, residence floors, etc.	4¼	4½	4¾	1	1	1¾	⅜″
		Average Sand		Sacks	Cu.ft.	Cu.ft.	
Fence posts, flower boxes, garden furniture; work of very thin sections; all concrete in contact with weak acid or alkali solutions.	3¾	4	4½	1	1¾	2	¾″
6-Gallon Paste for Concrete to Be Watertight or Subjected to Moderate Wear and Weather							
		Average Sand		Sacks	Cu.ft.	Cu.ft.	
Watertight floors such as basement dairy barn, milk house, etc. Watertight basement walls and pits, walls above ground, grain bins, silos, manure pits, scale pits, dipping vats, dams, lawn rollers, hot beds, cold frames, storage cellars, etc. Water storage tanks, cisterns, septic tanks, sidewalks, feeding floors, barnyard pavements, driveways, barn approaches, steps, porch floors, corner posts, gate posts, piers, columns, sills, lintels, chimney caps, etc. Concrete subjected to moderate wear or frost action; base course work; all reinforced concrete.	4¼	5	5½	1	2¼	3	1½″
7-Gallon Paste for Concrete Not Subjected to Wear, Weather or Water							
		Average Sand		Sacks	Cu.ft.	Cu.ft.	
Foundation walls, footings, retaining walls, engine bases, mass concrete, etc., not subjected to weather, water pressure or other exposure.	4¾	5½	6¼	1	2¾	4	1½″

NOTE—It may be necessary to use a richer paste than is shown in the table because the concrete may be subjected to more severe conditions than are usual for a structure of that type. For example, a water storage tank ordinarily is made with a 6-gallon paste. However, the tank may be built in a place where the soil water is strongly alkaline, in which case a 5-gallon paste is required.

gallons are then added to a one-sack batch. Since pebbles hold little moisture, only the water contained in the sand need be considered.

Determining Proportions by Trial Mixture

As a trial mixture for determining correct proportions of sand and pebbles for watertight concrete, 1 sack cement to 2¼ cubic feet sand to 3 cubic feet pebbles (1:2¼:3) mix is recommended.

It may be necessary to change the proportions of sand and pebbles slightly in order to obtain a smooth, plastic, workable mixture which will place and finish well. For example, if addition of the recommended quantity of water for the suggested trial proportions gives a mixture that is too wet, add more sand and pebbles in the proportions of about two parts sand to three parts pebbles until the right degree of workability is obtained.

On the other hand, if the trial mixture is too stiff, use less sand and pebbles in the following batches. In this way the exact proportions for the job can be obtained.

Helpful Suggestions on Proportioning

The following recommendations (Table II) will prove helpful in arriving at best proportion of sand to pebbles. All measurements are based on moist sand. If sand is absolutely dry (a condition seldom encountered) use 25 per cent less sand than quantities given in the table.

TABLE II

For coarse aggregates ranging from ¼ inch up to ½ inch, use approximately equal parts of sand and pebbles.

For coarse aggregates ranging from ¼ inch up to ¾ inch, use about ¾ as much sand as pebbles.

For coarse aggregates ranging from ¼ inch up to 1½ inches, use about half as much sand as pebbles.

What Is a Workable Mixture?

A workable mixture is one of such plasticity and degree of wetness that it can be placed in forms readily, and that with light spading or tamping will result in a dense concrete. It should be neither too dry nor too

wet. In a workable mixture there is sufficient sand-cement mortar to give good smooth surfaces free from rough spots, called honeycombing, and to bind the pieces of coarse aggregates into the mass so they will not separate out in handling.

In other words, there should be just enough cement-sand mortar to fill completely the spaces between the pebbles and to insure a smooth plastic mix. Mixtures with not enough sand-cement mortar will be harsh, hard to work and difficult to finish. On the other hand, use of too much sand should be guarded against as it will cause porous concrete and reduces the amount of concrete that can be made with a sack of cement.

The illustration shows how a workable mix will look when a trowel is drawn across it. *Under no circumstances should the ratio of water to cement from the quantities given in Table I be varied in order to make the mix more dry or wet.*

Aggregates

Aggregates for concrete should be clean, hard and free from dirt, loam, clay or vegetable matter. These foreign materials are objectionable because they prevent adhesion between the cement and the particles of aggregate. Concrete made with dirty aggregate hardens very slowly at best and may never harden enough to produce a good quality of concrete.

Sand should be well graded, that is, the particles should not all be fine nor all coarse, but should vary from fine up to those particles that will just pass a sieve having meshes ¼ inch square. If sand is well graded, the fine particles help to fill the spaces (voids) between the coarser particles; a dense concrete results. Under these conditions, a given amount of cement paste will bind together a greater mass of aggregates, thus increasing the amount of concrete obtainable with a sack of cement.

Pebbles, crushed stone, or other coarse aggregates should be tough, hard and free from impurities that are objectionable in sand. Stone containing a considerable quantity of soft, flaky or elongated particles is not suitable for making concrete. Coarse aggregates should be well graded with sizes ranging from ¼ inch up to 1½ or 2 inches, the maximum size being governed by the nature of the work. In thin slabs or walls, the largest pieces of aggregates should never exceed ⅓ the thickness of the section of concrete being placed.

Bank-Run Materials

Bank-run gravel, the natural mixture of sand and pebbles as taken from the pit, is seldom suitable for concrete unless first screened to separate sand from pebbles. When thus separated, materials may be recombined in correct ratio to give a workable mix as previously described. Most gravel banks contain either more sand or more pebbles than desirable; usually, there is too much sand. Money can generally be saved by screening out the sand and then re-combining sand and pebbles in correct proportions.

A concrete mixture which contains the correct amount of cement-sand mortar; with light troweling all spaces between pebbles are filled with mortar. Note appearance on edges of pile. This is a good workable mixture and will give maximum yield of concrete with a given amount of cement.

Water

Water used to mix concrete should be clean, free from oil, alkali and acid. In general, water that is fit to drink is suitable for concrete.

Accurate Measurement Essential

All materials, including water, should be accurately measured for every batch. A bot-

tomless frame made to hold exactly 1 cubic foot, 2 cubic feet or any other convenient volume serves as a measuring box for sand and pebbles. A pail marked off on the inside to indicate gallons and half-gallons is commonly used for measuring water.

Stiff, medium and wet mixes of concrete. The stiff mix is suitable for foundations, floors and work of that character. The medium mix is suitable for tank walls, fence posts and similar work. The wet mix is used only for very thin sections such as vases and garden furniture.

Mix Thoroughly

Concrete may be mixed by machine or by hand. In either case, mixing must proceed until stones or pebbles are completely coated with a mortar of sand and cement.

Practically all standard batch-type machine mixers on the market will render satisfactory service and pay for their cost in farm construction by saving labor and insuring more thoroughly and uniformly mixed concrete. In case one person has insufficient work to justify the purchase of a mixer, it is often possible to get several neighbors to share the expense of buying a machine which all may use.

Hand Mixing

For hand mixing, a tight floor or mixing platform is required. A platform may be constructed especially for the purpose, or space cleared in one of the buildings which has a level, watertight floor.

The method generally used for hand mixing follows: Spread the measured amount of sand out on the platform, distribute the required quantity of cement evenly on top of the sand and turn with square-pointed shovels until the mixture is uniform in color. At least three turnings are necessary. Then spread the measured amount of pebbles and mix thoroughly as before until the mass has the same even color throughout. A hollow is then formed in the center of the pile and the exact quantity of water poured in, materials in the pile being gradually turned into the water with shovels and mixed until the cement, sand and pebbles have been thoroughly and uniformly combined and the mixture has the same color and plasticity throughout.

Placing

Concrete should be placed in the forms within 45 minutes. It should be deposited in 6 to 10-inch layers and thoroughly spaded. This compacts the concrete, releases air pockets, and works large particles away from the face of the forms.

Curing

Moisture is necessary for the proper hardening of concrete. If this fact is kept in mind no difficulties will be encountered in the proper curing of concrete on the farm. Floors

Steps in the work of mixing concrete by hand. Thorough mixing is essential for satisfactory results.

A mechanical mixer helps in securing a high quality concrete. Just as in hand mixing, correct proportions of cement, aggregate, and particularly water must be controlled. Materials should be mixed at least one and preferably two minutes to obtain workability.

and walks are commonly given a covering of 2 or 3 inches of earth, straw or sand which is kept moist by sprinkling for 7 to 10 days. Wall sections are protected with moist canvas or burlap.

Reinforcing

Reinforcement is the term used to describe steel bars or large or small mesh metal placed in concrete to increase its tensile strength. In a concrete lintel over a door or window opening or in a beam, for example, reinforcement is placed near the lower side, as that is the side which tends to pull apart when the beam or lintel is loaded.

Reinforcing steel should be free from rust, scale, paint or other coatings that will reduce the bond between concrete and steel. It is necessary to clean bars or rods which do not meet this requirement. It is poor economy to use old woven wire fence, farm machine axles or frames and similar discarded materials for reinforcing concrete.

Reinforcement should be accurately placed and anchored before the concrete is placed. Ordinarily, reinforcement is placed after the forms are built.

In general, it is recommended that all reinforcing steel be placed at least ¾ inch from the surface of the concrete. The concrete should be tamped, spaded, or otherwise handled to be sure that it is worked around and under all reinforcement and embedded fixtures. Reinforcing is spliced by overlapping the ends of the rods or bars a distance equal to 40 times the diameter of the reinforcing steel.

Good forms, tight enough to prevent water and cement paste from escaping through the cracks, and well braced to prevent bulging, are essential in obtaining a first-class, attractive concrete job. The concrete should be well-spaded next to the forms to eliminate air pockets and prevent a honeycombed appearance when forms are removed.

This attractive concrete manger in a dairy barn resulted from properly proportioned concrete placed in well-made forms and troweled correctly.

How to Figure Quantities

QUANTITIES OF CEMENT, FINE AGGREGATE AND COARSE AGGREGATE REQUIRED FOR ONE CUBIC YARD OF COMPACT MORTAR OR CONCRETE

(See Table I, page 52, for quantities of mixing water)

MIXTURES			QUANTITIES OF MATERIALS				
Cement	F.A. (Sand)	C.A. (Gravel or Stone)	Cement in Sacks	Fine Aggregate		Coarse Aggregate	
				Cu. Ft.	Cu. Yd.	Cu. Ft.	Cu. Yd.
1	2	...	12	24	0.9	...	....
1	3	...	9	27	1.0	...	....
1	1	1¾	10	10	0.37	17	0.63
1	1¾	2	8	14	0.52	16	0.59
1	2¼	3	6¼	14	0.52	19	0.70
1	2¾	4	5	14	0.52	20	0.74

1 sack cement = 1 cu. ft.; 4 sacks = 1 bbl.

MATERIALS REQUIRED FOR 100 SQ. FT. OF SURFACE FOR VARYING THICKNESSES OF CONCRETE OR MORTAR

(See Table I, page 52, for quantities of mixing water)

Thickness of Mortar or Concrete (Inches)	Amount of Mortar or Concrete (Cu. Yd.)	Proportions:								
		1:2			1:3			1:1:1¾		
		C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)	C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)	C. (Sacks)	F.A. (Cu. Ft.)	C.A. (Cu. Ft.)
⅜	0.115	1.4	2.8	....	1.0	3.0	....	....	....	....
½	0.15	1.8	3.6	....	1.3	4.0	....	....	....	....
¾	0.23	2.7	5.4	....	2.0	6.0	....	2.3	2.3	3.9
1	0.31	3.7	7.4	....	2.7	8.1	....	3.1	3.1	5.3
1¼	0.38	4.5	9.0	....	3.3	10.0	....	3.8	3.8	6.5
1½	0.46	5.4	10.8	....	4.0	12.0	....	4.6	4.6	7.8
1¾	0.54	6.4	12.8	....	4.7	14.1	....	5.4	5.4	9.2
2	0.62	7.3	14.6	....	5.4	16.2	....	6.2	6.2	10.5
		1:1¾:2			1:2¼:3			1:2¾:4		
3	0.92	7.5	12.9	14.7	5.8	12.9	17.5	4.6	12.9	18.4
4	1.24	10.0	17.3	19.9	7.8	17.3	23.6	6.2	17.3	24.8
5	1.56	....	....	....	9.8	21.7	29.6	7.8	21.8	31.2
6	1.85	....	....	....	11.5	26.0	35.2	9.3	26.0	37.0
8	2.46	....	....	....	15.4	34.4	46.8	12.3	34.4	49.3
10	3.08	....	....	....	19.3	43.2	58.5	15.4	43.2	61.6
12	3.70	....	....	....	23.1	51.8	70.4	18.5	51.8	74.0

C. = Cement in Sacks.
F.A. = Fine Aggregate (Sand).
C.A. = Coarse Aggregate (Pebbles or Broken Stone).
Quantities may vary 10 per cent either way depending upon character of aggregate used. No allowance made in table for waste.

MORTAR MATERIALS REQUIRED FOR CONCRETE MASONRY (8-in. Wall)

Note: Amount of mortar required is subject to wide variation, depending upon wastage and how joints are made. The following figures represent general practice on the basis of 25 per cent wastage and ⅜-inch mortar joints, the mortar joints being non-continuous through the wall.

For Ordinary Work

One sack cement, 1 cu. ft. lime and 6 cu. ft. sand will make mortar sufficient to lay up the following:

150 8x8x16-inch block, or

200 5x8x12-inch concrete building tile.

For Special Work

One sack cement, 10 pounds lime and 3 cu. ft. sand will make mortar sufficient to lay up the following:

75 8x8x16-inch concrete block, or

100 5x8x12-inch concrete building tile.

HOW TO USE TABLES FOR CALCULATING QUANTITIES

Problem 1:

What quantities of materials are required for a monolithic concrete foundation wall 34 feet square, outside measurements, 12 inches thick, 7 feet high, with a footing 12 inches thick and 24 inches wide, using a 1:2¼:3 mixture in the wall and a 1:2¾:4 mixture in the footing?

Solution:

The wall contains 924 square feet of surface, 12 inches thick, deducting for duplication at corners.

Referring to table on page 56 under 1:2¼:3 mixture for 12-inch walls, 23.1 sacks of cement are required for each 100 square feet of surface. Dividing 924 by 100 gives the number of times 100 square feet are contained in the total wall surface and multiplying this result by 23.1 gives the total number of sacks of cement required. Similar calculations are made for the fine aggregate and the coarse aggregate in both the wall and the footing, noting that the width of the footing, 24 inches, is twice the 12 inches thickness.

Making a drain from concrete gutter in dairy barn. A steel trowel is used to give the concrete a dense, smooth, impervious surface.

$\frac{924 \times 23.1}{100}$ = 214 sacks cement.

$\frac{924 \times 51.8}{100}$ = 479 cubic feet fine aggregate.

$\frac{924 \times 70.4}{100}$ = 651 cubic feet coarse aggregate.

The footing contains 264 square feet of surface, 12 inches thick, deducting for duplication at corners, or 264 cubic feet.

$\frac{264 \times 18.5}{100}$ = 49 sacks cement.

$\frac{264 \times 51.8}{100}$ = 137 cubic feet fine aggregate.

$\frac{264 \times 74}{100}$ = 196 cubic feet coarse aggregate.

Total materials required for footing and wall: 263 sacks cement, 616 cubic feet fine aggregate, 847 cubic feet coarse aggregate.

Problem 2:

What quantities of materials are required for 1:2 cement plaster coat, 1 inch thick on the lower 4 feet of the above foundation?

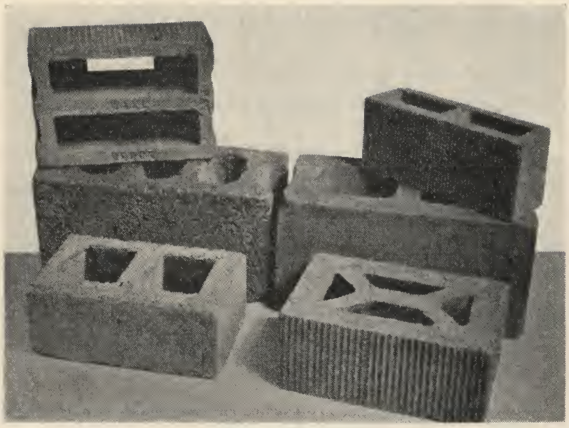
Solution:

Perimeter of foundation: 4x34 feet = 136 feet. This multiplied by height of plaster coat, 4 feet equals 544 square feet.

$\frac{544 \times 3.7}{100}$ = 20 sacks of cement.

$\frac{544 \times 7.4}{100}$ = 40 cubic feet sand.

Using the method illustrated above and referring to the tables on page 56, it will be comparatively easy to figure accurately the quantities of cement, sand and coarse aggregate needed for practically any farm concrete job.



Typical concrete building units. The large units are concrete block; the smaller ones are concrete building tile.

The true shape and large size of concrete masonry units are ideally suited to economical farm building construction.

Concrete Masonry Construction

CONCRETE masonry is a term commonly used to denote an assembly of concrete block or concrete tile in building construction.

Concrete block and concrete building tile are obtainable almost everywhere and are widely used in rural communities. The popularity of these building units for farm buildings is due, in a large measure, to their qualities of permanence, general adaptability and economy.

Convenient Sizes and Shapes

Concrete masonry units are obtainable in several sizes and shapes. For walls 8 inches thick, the standard 8x8x16-inch block is most commonly used—for 10 and 12-inch thick walls, block 10 and 12 inches thick are provided. Concrete building tile are smaller and usually have thinner wall sections than block, a common size being 5x8x12 inches with wall sections about an inch thick. A 5x8x12-inch tile is suitable for building a wall either 8 inches or 12 inches thick, according to the way it is turned in the wall.

A single thickness of block or tile will generally prove adequate for the construction of most farm buildings. Usual wall thickness for poultry houses, hog houses, smoke houses and similar structures is 8 inches. Basement walls of barns are commonly made 10 to 12 inches thick. For a two-story residence, basement walls are generally made 12 inches thick and the walls above the first floor, 8 inches thick.

Lengths of units likewise fit dimensions of most farm structures. It is a simple matter to lay out a building so that its width and length as well as distance between doors and windows are equal to a given number of full and half-length blocks. For example, a wall 24 feet long will take 18 full lengths of 16-inch block in each course; a wall 26 feet long will require 19 full lengths and one half-length block. Half-length units, quarter units, and units for use on either side of window or door openings, called "jamb" block, are provided. Consequently, it is rarely necessary to cut units on the job.

Wall Finishes

Most concrete masonry manufacturers make plain, flat-faced block or tile and one or two popular types of faced block. For basement walls below grade, the plain unsurfaced block is extensively used. For work above grade, the owner may select faced units or he may use the plain unsurfaced block, depending on the effect desired. For farm dwellings, it is customary to apply a portland cement stucco finish. For other farm buildings, the plain unsurfaced block

when carefully laid presents a wall of satisfactory appearance. Such walls may be inexpensively painted with portland cement paint to provide an attractive finish. See page 49 for further information about stucco surfacing.

Preparing Mortar

Portland cement mortar is recommended for laying concrete block and building tile. For ordinary work, mortar composed of 1 part portland cement, 1 part lime and not more than 6 parts sand, all measured by volume, is satisfactory. For extra strength and density, as in block granaries, silos and similar structures, the amount of lime used should be limited to not more than ¼ of the volume of the cement. This amounts to about 10 pounds lime to 1 sack cement and 3 cubic feet sand. Data for figuring mortar quantities are given on page 56.

Corners of the wall are built up first. Intermediate block are then laid to the chalk line to obtain a straight, true wall.

Lime is added to cement mortar to make it more plastic or "fat." Its use makes the particles of mortar cling together, yet keeps them from sticking to the trowel. Without lime in the mortar, one may have difficulty in getting vertical strips of mortar to stick to the block until the next unit has been put into position. The quantities of lime used should not be greater than those given in the preceding paragraph, as larger amounts tend to weaken the mortar.

Lime is obtainable in most communities as lump lime, usually carried in barrel lots, or commercially hydrated lime, sold in sacks. Lump lime requires "slacking" before it is ready for use in mortar. "Slacking" consists of adding water. Slacked lime, or "lime putty" as it is commonly called, will keep indefinitely if not allowed to dry out.

Mortar should be mixed thoroughly, using just enough water to give the desired plasticity and workability. Thorough mixing improves the quality of the mortar.

The customary way of mixing mortar is by hand, although machines may be used. Tools for hand mixing are hoe, shovel and mortar box. Mix only enough mortar at one time so that the entire batch can be used before it begins to harden. Cement mortar that has partly "set" should not be used.

For walls which are to be stuccoed or plastered, the surplus mortar which is pressed out when the masonry units are laid may be simply cut off flush with the surface. If walls are to be exposed, joints are finished with greater care. The concave type of joint is generally preferred for farm buildings. It is made by drawing the point of a small trowel (pointing trowel) along the joint after the mortar has begun to harden. This operation compacts the mortar and produces a water-tight surface. Both vertical and horizontal joints may vary from ¼ inch to ⅜ inch in thickness. Mortar joints of a different color are sometimes desired, in which case colored mortar is used.

Laying Concrete Masonry

Two men generally work together in laying concrete block or building tile. One, a helper, places the block or tile on the scaffold, prepares mortar and brings it within easy reach of the other, who places the masonry units. The mortar is brought

The same trowel that is used for laying the block may be employed in striking off the mortar joints.

either in a hod or in a pail or may be hauled in a wheelbarrow. The hod is convenient when mortar is to be carried up a ladder. However, pails and a rope and pulley arrangement may be used. Mortar is dumped upon a mortar-board—a platform about 3 feet square made of boards and placed near the mason.

Trial Measurements Are Important

The outline of the wall is first marked off on the concrete footing, either scratched in the concrete or marked with a chalk line, and the units laid along this line to determine the exact number of full-length and half-length pieces needed for each side of the building or section of wall. No mortar is used in this trial, block or tile being removed and properly laid in mortar after their spacing has been decided on. Laying units out in this manner insures equal thickness of mortar between them and guards against the possibility of having to break block or tile to fill in a row, a condition sometimes necessary when the work is started without regard to the proper spacing. Units should not be placed over ⅜ of an inch apart, as this is the maximum thickness of vertical joint recommended.

Uniformity in horizontal joints is desirable just as much as in vertical joints. Heights of courses may be marked off on a straight-edged board and this board used as a guide throughout the job to insure uniform thickness of joints. This method likewise insures obtaining a wall of the desired height. Both vertical and horizontal joints may vary from ¼ inch to ⅜ inch in thickness. Consequently, for a wall 16 courses high, for instance, there is a leeway of 2 inches in wall height, depending on the thickness of mortar joints.

Wall corners are usually built first. This is desirable in order that units can overlap and properly tie the two walls together, also to facilitate lining up horizontal mortar joints. The gauge or "marker" mentioned in preceding paragraph serves as a guide in building up the corners to the proper heights. After the mortar has hardened sufficiently to hold a nail, a chalk line is stretched from corner to corner, being fastened to nails driven into the mortar just above the first course of block or tile. This chalk line marks the height and location of each unit in the row. If corner block or tile are accurately placed and plumbed and the line is not allowed to sag, the wall will be plumb and true, provided units are laid to this line. Masonry units should be laid to the level of the line but not touching it; best practice is to allow just about the thickness of the trowel blade between units and chalk line.

Laying Up the Walls

Block or tile are placed so that vertical joints in one course come halfway between those in the next course below. This is called "breaking joints" and is done by the use of

A smooth, true, watertight basement wall of properly laid concrete masonry units.

half-units in starting alternate courses. In laying the wall, a mason's trowel is used to spread the mortar, to "butter" the ends of the units, and to gather up the surplus mortar which is pushed out as units are pressed into position. Care should be taken to "butter" inner and outer edges of both units where they come together in order to insure well-filled vertical mortar joints. Each unit should be lined up with the chalk line shortly after it is placed on the wall, and once in place it should not be moved. Moving units after the mortar has begun to harden is likely to destroy the bond and result in a defective wall.

In the construction of gable-ends with concrete block or tile, as in hog houses and poultry houses, general practice is to build the walls to the height of the eaves and then erect the roof. After the roof frame-work has been erected and before the sheathing boards are nailed into place, the wall for the gable-end is built. This method of construction generally proves more satisfactory than to build the wall to the full height before the roof framing is enclosed.

Framing Around Openings

Frames for doors and windows are put in as walls are built, or framed into prepared openings later. In either case, special "jamb" units are desirable. At floor levels, special "cut-away" joist units provide space for the joists. Often units where joists occur are omitted and veneer block or tile are set on the outside wall. The space between joists is then filled with fractional units or with concrete.

Door and window frames are placed in position and the wall built up around them.

Other Materials Bolted to Walls

Wood framing members built on top of masonry walls are usually attached to a plate or sill bolted to the top course. These bolts should extend through at least one course of masonry. They are usually spaced 6 feet apart or less. For firm anchorage, fill concrete around the bolts. In districts where hurricanes are prevalent, additional roof anchorage should be provided by running bolts down through several courses and securely anchoring them. Wooden members are attached to walls by placing nailing blocks in the mortar joints at proper intervals. For some types of concrete masonry, made from special aggregates, nails may be driven directly into the units.

Illustrating the method of "buttering" ends of a concrete building unit.

Painting

If a white or other color is desired for above-grade concrete masonry walls, finish the walls with one or two coats of portland cement paint. This decorative treatment is both durable and economical. To properly cure, care should be taken to keep the paint damp for two or more days. If allowed to dry out immediately after it is applied the paint may dust off.

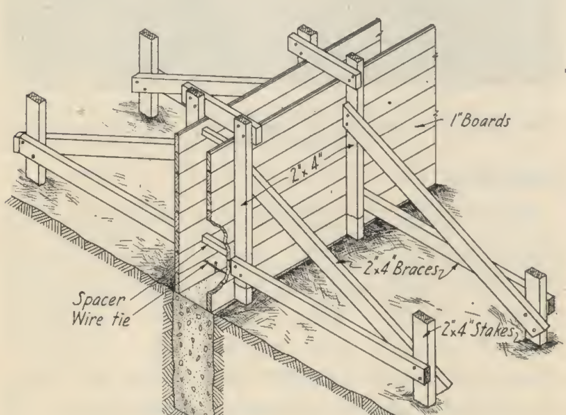
Laying Out the Foundation

Building a monolithic concrete foundation.

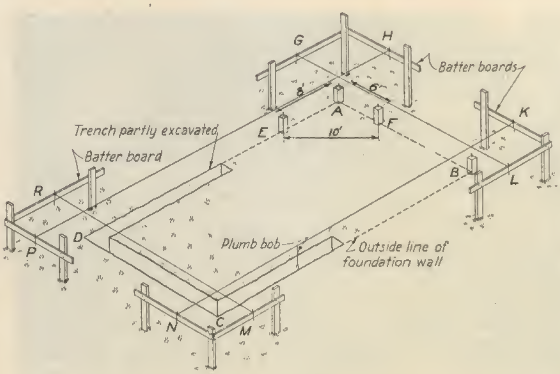
WHEN surveying instruments are not available, one of the simplest methods for laying out foundations is known as the right triangle method. A triangle with sides 6, 8 and 10 feet long is a right triangle, the 6 and 8-foot sides forming a true square.

First, a base line is established, marking out one end or side of the new building. See line AB on the accompanying drawing. Stakes are set at A and B on this line, locating two corners. In the top of stake A a nail is partly driven into the center. This nail accurately locates the corner. On the line AB another stake is driven at F, 6 feet from stake A. A nail is driven into the top of this stake exactly 6 feet from the nail in stake A. Stake E should be driven so that its center will be exactly 8 feet from stake A and exactly 10 feet from stake F.

The corner represented by the angle EAF is a right angle; the line AE extended to D will form the second boundary line of the building and D will represent the third corner. Other corners are located in the same manner. After this has been done, strings are stretched over the corner stakes, A, B, C, D, and carried to outside supports called "batter boards" as indicated by G, H, K, L, M, N, P, R. The top of the horizontal batters should be set at first floor level or some other convenient fixed elevation. The building lines may be projected from the strings to the ground by means of a plumb bob suspended as shown in the drawing. When the stakes G, H, K, L, M, N, P, R have been set and the strings indicating the



Forms for monolithic walls above grade. (Drawing B-1159)



This method of laying out foundations assures true walls that are accurately placed to receive the remainder of the building.

layout of the building transferred to them, the corner stakes A, B, C, D and stakes E and F are removed so that the trench may be excavated. Nails should be driven into the cross pieces between standards where the strings are fastened, so that in case the strings are broken or removed they can be accurately replaced. Having found the building line, it is easy to locate piers, posts, columns or other intermediate supports.

Building the Walls

WALLS for farm structures require bearing on firm soil to be safe against settlement. Footings of monolithic concrete are usually placed beneath building walls, as they are easy to build and provide an even surface on which to start the wall proper.

Extend Footing Below Frost-Line

For all farm buildings it is essential to extend the foundation below possible frost penetration, even though firm bearing soil is found at a shallower depth. Then the foundation will not be upheaved by freezing. The depth of frost action varies in different sections; common practice in the locality will generally be the best guide in determining the depth necessary.

The weight of the building and its contents as well as the carrying capacity of soils are taken into account in computing proper dimensions for footings under walls and piers. For most farm buildings, however, the loadings are generally small, and other factors, such as stability and convenience of construction, generally govern the footing sizes. Eight inches, the usual minimum thickness of wall, is likewise the least width for the footing. A greater footing width will often simplify the work of starting the wall, and will add stability to the structure. "Spread" footings are commonly used under walls of farm buildings. Footings 12 inches wide and 8 inches thick will serve for farm buildings such as hog houses, poultry houses, milk houses and structures of that size. Small residences generally require footings 18 inches wide and 12 inches deep. Under the basement walls of a barn, a concrete footing 2 feet wide and 12 inches deep will usually be sufficient. Interior posts supporting mow floors should have carefully designed footings to carry the maximum load. (See details for piers of general purpose barn on page 6.)

Care should be taken to see that door and window frames are plumb and level before walls are built around them.

Earth Forms

In building foundations for small structures without basements, monolithic concrete is generally the most suitable material as it is placed easily and economically. Earth walls of the foundation trench may serve as forms provided the dirt does not cave. The trench should be excavated carefully so that sides are even and vertical, and care taken, when depositing or spading concrete, that earth is not pushed into the trench. Planks laid along the edge of the trench will protect the dirt from caving and provide a convenient runway for wheelbarrows. In soft, caving ground and for monolithic walls above ground, forms are required.

Wood Forms

Forms should be rigid and well braced in

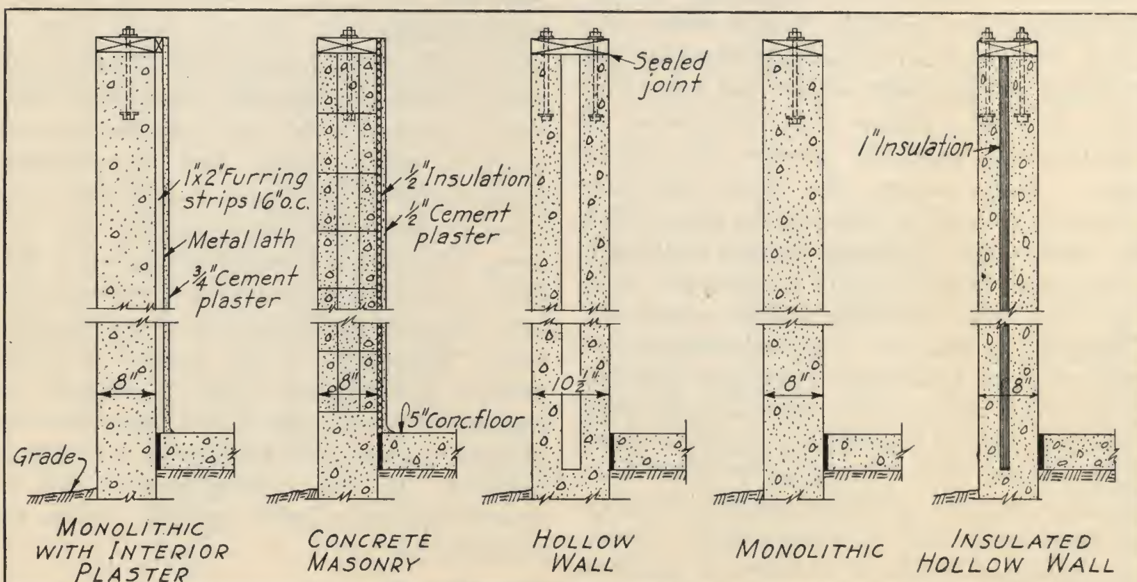
order to withstand the pressure of wet concrete and produce a straight, even wall. Concrete when wet weighs about 150 pounds per cubic foot. For wall forms, 1-inch boards will safely withstand pressure of concrete 3 feet deep without bulging when form studs are not more than 24 inches apart; 2-inch planks on form studs 40 inches apart will safely carry the same pressure. For deeper sections of walls, the form studs may be placed closer together or heavier forms used. Braces and studs for supporting form boards or sheathing must be strong enough to hold forms in a true line; 2x4's or 2x6's are usually satisfactory. These may be strengthened at intervals by wire braces run through the forms and drawn tight. Inner and outer forms are clamped or wired together to preserve their proper spacing. When wires are used, wood spacers or "spreaders" of a length equal to the desired wall thickness hold the wires taut and insure proper distance between forms. Spacers are removed as concrete is placed.

For foundations and walls where appearance is not important, rough lumber is satisfactory for forms. Smooth lumber is used for exposed work. Forms are often used several times and if care is taken the lumber can generally be used for other work. Surfaces of forms in contact with concrete should be oiled to prevent concrete from sticking.

Concrete Mixtures

If the foundation wall is to form a part of the enclosure of the basement or cellar, the recommended mixture for monolithic construction is 5 gallons water per sack cement, to which such amounts of wet sand and pebbles are added as will produce a rather thick consistency. For footings and walls which need not be watertight, 5½ gallons water are used per sack cement. For above-grade walls, the 5-gallon mix is recommended. (See Table I on page 52 and read directions for proportioning on pages 52 and 53.)

Concrete should be placed in the forms in layers of from 6 to not more than 10 inches deep and in a continuous operation, if possible, to avoid construction joints. Concrete of the consistency described above will require only light tamping and spading to obtain smooth, even surfaces. It is well to complete a foundation or wall in one day's



Several types of wall construction. The cement plaster and insulation may be applied to the hollow wall or the monolithic wall. (Drawing B-2188)

operation, if possible, to avoid construction joints. If it is necessary to stop work before a wall can be finished, the concrete should be leveled off and the surface roughened by scratching it, or by placing large pebbles in it, projecting about halfway out of the concrete. This will help to secure a good bond between old and new concrete when work is resumed. Before depositing an additional layer, the roughened surface of hard concrete should be scrubbed to remove any dirt or scum, and just before placing new concrete it should be painted with cement and water mixed to the consistency of thick cream.

Basement Walls

Residences, storage cellars and other farm structures built partially or wholly underground also make extensive use of concrete block and tile for walls. These units can be laid up quickly and economically. No forms are required. Smooth-faced, unsurfaced block are generally suitable. See page 60 for complete instructions.

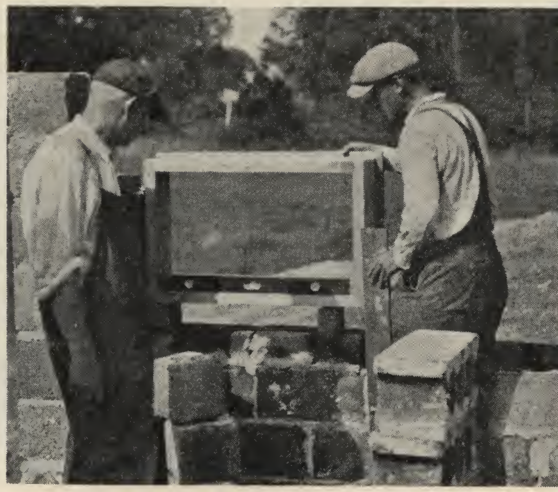
Plaster Masonry Walls Below Grade

The mortar joints between blocks are usually pointed inside and are cut off flush on the outside. To assure a dry basement wall, two or more coats of cement plaster may be applied to the exterior surface. The recommended mix for cement plaster is 1 sack cement to 3 cubic feet clean sand mixed rather dry. It is applied with a plasterer's trowel.

Walls Above Ground

Several types of permanent wall construction suitable for farm buildings are shown on page 64. Variations of these are possible, such as the use of an insulated covering on the inside or a stucco coating on the outside.

The type of wall used will depend on conditions to be met. Either type, monolithic or masonry, without interior or exterior covering, will usually be suitable, but where more protection against excessive heat or cold is desired, wall coverings and insulation as illustrated may be used. The hollow type monolithic wall construction shown is also used to provide insulation. Special forms for this construction are obtainable in most parts of the country.



Plumbing and leveling a window frame. The frame is then braced in place while the walls are completed.

Reinforced Concrete Lintels

Lintels over openings in concrete masonry walls may be precast units or they may be built on the job. When built on the job, general practice is to build the wall one course higher than the opening, leaving space for lintel. Forms are then built of two boards, one for each side. These boards must be about one foot longer than the opening and several inches wider than the depth of lintel. They are placed one on either side of the wall and wires are run through holes in the boards and twisted tight. The pressure of the boards against the wall holds the forms in place. The boards are leveled with the top of the row of block, and wood spacers are placed between the boards to hold them apart until concrete is placed. The bottom form board is then placed, with length equal to the width of the opening.

Reinforcing steel as required is put into position and the concrete then placed. Concrete for lintels should contain not over 6 gallons water per sack cement, with about 2¼ parts sand and 3 parts pebbles. Spading is desirable as it insures smooth, even surfaces for the finished lintel.

Lintels over openings in concrete masonry walls are similar to concrete beams in floors and generally require steel reinforcement to provide tensile strength. The following schedule is generally adequate for lintels which carry an 8-inch masonry wall:

Precast concrete lintels were used above basement door and window openings for this house addition.

For 2-foot 4-inch span use two 3/8-inch bars in 8x8-inch lintel.

For 3-foot span use two 1/2-inch bars in 8x8-inch lintel.

For 3-foot 10-inch span use two 3/4-inch bars in 8x8-inch lintel.

For 4-foot 6-inch span use two 5/8-inch bars in 8x10-inch lintel.

For 5-foot 2-inch span use two 5/8-inch bars in 8x12-inch lintel.

For 6-foot span use two 7/8-inch bars in 8x12-inch lintel.

Ends of the bars should be bent in the shape of hooks to provide good anchorage, and placed about 2 inches above the bottom of the lintel, about 2 inches from each side.

Placing the Floors

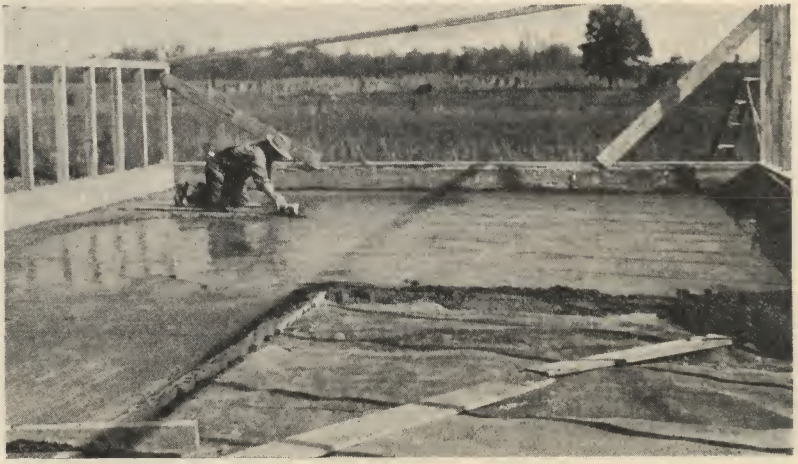
PERMANENT, easy-to-clean, concrete floors are standard construction in modern farm buildings. Concrete floors are put into new buildings as a matter of course; where old farm structures are being modernized, a durable concrete floor is likewise a first consideration.

One of the primary requirements for a floor, especially in farm buildings where animals are to be housed, is that it remain dry. See page 52 for complete instructions for making watertight concrete and for description of a workable mix.

Dry Base Essential

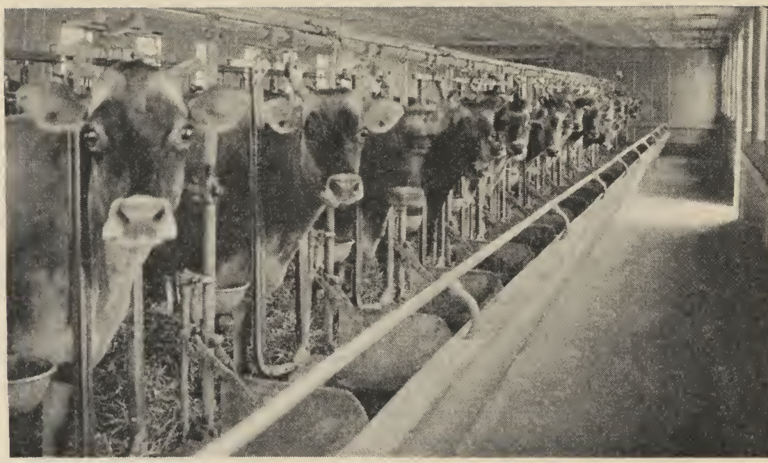
While well-made concrete is absolutely watertight, good practice generally recommends that the floor be placed on a fill at least 6 inches higher than the surrounding grade. This fill may consist of well-compacted cinders, gravel or a mixture of these materials. If the site on which the floor is to be built is poorly drained, it is advisable to run drain tile around the foundation to intercept water which might otherwise drain underneath the floor. Such a tile line should be placed about 2 feet below ground level and sloped toward an outlet to insure quick, complete drainage.

Floor thicknesses vary for different types of farm buildings, depending largely upon the traffic to be carried. In general, the floor should not be less than 4 inches thick.



Poultry house floor placed on top of waterproof paper and cinder fill.

Same Mix Used Throughout



Properly finishing the concrete assures sanitary dairy barn floors that are not slippery, yet are easily kept clean.

One-course construction is generally recommended for farm building floors. This term means that the full thickness is placed using the same mixture of concrete throughout. With a workable watertight mixture as described on pages 51 to 53, it is easy to get the desired finish.

Construction

Concrete for floor work should be rather stiff, requiring some tamping to set it into place. It is evened up or struck off flush with a straightedge, which is worked back and forth over the concrete to bring it to the desired level. In basements, wall footings often serve as guides for the straightedge extending from wall to wall. Large areas usually are built in strips or sections, 2x4's or 2x6's being set on edge as forms for the section being built. Stakes hold the forms in position. Such forms provide a guide for the strikeboard. Floors for farm structures should be placed in one operation whenever possible to avoid construction joints. However, joints between old and new work can be made watertight if the surface is roughened, cleaned and painted with cement paste of a creamy consistency before proceeding with the new work.

Choose Time for Finishing Carefully

Place no more area of concrete floors than can be finished the same day. The surface should not be finished at once but given time in which the concrete can stiffen. Finishing the surface at once may cause fine particles to come to the top; these produce a film of mortar on the surface which does not wear well and may check or crack.

Too much troweling should be avoided. In general, the least amount of finishing that will produce the desired surface texture is desirable. The strike-off or straightedge rather than the trowel should be depended upon to level off the concrete. Overfinishing tends to bring an excess of water and cement paste to the surface, making a soft top layer that may "dust" or check, as when the concrete is troweled when not hardened sufficiently for good finishing.

Methods of Finishing

Floors in most farm buildings give best service when finished with a wood float. This provides a smooth yet gritty non-skid surface. Finishing with a steel trowel provides a smoother surface, sometimes desirable. Thus, a poultry house floor is finished smooth with a steel trowel to provide a surface on which fowls will not wear their claws in scratching. Bottoms of gutters and mangers in dairy barns should be steel-troweled to provide a non-absorbent surface. Floors in structures used for the housing of grain prove most satisfactory when trowel-finished, as shovels wear away rapidly if the floor surface is gritty.

Curing

Recommendations for curing given on page 54 should be followed carefully to insure best results. For corn cribs and granaries, it is well to allow concrete to harden six weeks or longer before using. In dairy barns, hog houses and other buildings for housing stock, the floor may be put into service after 10 days' curing.

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PORTLAND CEMENT ASSOCIATION

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